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OF THE

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National Fire Protection Association

INTERNATIONAL

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Washington Post.

More than $500,000 worth of fire apparatus, manned by some three hundred firemen summoned on five alarms, was powerless to prevent practically a total loss — $400,000 — in this Washington, D. C., shoe store on December 12, 1937. A few thousand dollars spent for improvements, such as protection of vertical openings, automatic sprinklers, automatic fire alarms, might have prevented this loss.

The Quarterly

Vol. 31 January, 1938 No. 3

The National Fire Codes Published as Part II of this QUARTERLY, the National Fire Codes for Flammable Liquids and Gases provide an impressive illustration of the importance, extent and variety of the standards developed by N.F.P.A. committees and adopted by the Association in annual meetings. This volume has been prepared in response to requests from N.F.P.A. members whose work calls for the use of N.F.P.A. standards on a variety of subjects and who find it increasingly difficult to keep track of the numerous separate standards when printed in the small pamphlet form. It is hoped that this volume will meet a real need. Furnished to all N.F.P.A. members, without extra charge, it is a further addition to the extensive service given to all N.F.P.A. members, at a membership dues cost which is very moderate for an organization like ours. This is strictly in the nature of an additional service; there is no thought of abridging in any way the present publication of the several standards in small pamphlet form, which is necessary to meet the needs of users who are concerned chiefly with only one or two separate standards at any one time. It is possible to provide items such as the volume of National Fire Codes only through sales of additional copies to help in covering the cost. It is hoped that the present volume may be sufficiently popular so that a large number of extra copies may be sold.

The size of this volume is an impressive exhibit of the extent of a single segment of N.F.P.A. committee activities. The 36 standards assembled in the present volume are only those dealing specifically with flammable liquids and gases. If all of the N.F.P.A. standards could be similarly published, the total number of items would be three times as great and there would be an even greater proportional increase in the number of pages.

* * * * *

Recession Fire Losses Preliminary estimates of fire losses for 1937 reported on another page of this QUARTERLY show a loss slightly lower than similar estimates for the preceding year. The decreased loss is a source of gratification to fire protection authorities generally, but there is some concern about the increase in losses the last two months of the year, as compared with November and December 1936. This reversal of trend in the fall appar-

ently reflects the change in business conditions. Losses in the first nine months of the year were lower, as might have been expected under the conditions of improved business.

The factors influencing the fire loss are so complex that it is impossible to make any intelligent forecast of the trend of fire losses during the coming year, even were information available as to what might be expected in respect to the trend of business conditions. In general an increase in fire losses follows a decline in business, but there are also factors operating in the opposite direction, and a peak of fire losses may come at the height of business activity.

* * * * *

Fire Department Budgets and Fire Losses Studies of municipal administration often compare fire department budgets with fire losses, attempting to draw conclusions from their relationship. Citizens sometimes question a large fire department budget on the ground that the annual fire losses of the city are so small that no large expense is justified for fire protection, failing to realize that the losses are small only because of the fire department. In some cases, to be sure, there is no determinable relationship between fire department expenditures and efficiency as measured in reduced fires losses, but there are some instances where the relationship is very clear. In Grand Rapids, Michigan, for example, a reduction of 18% in man power of the fire department has been followed by a doubling of fire losses.

* * * * *

Shanghai Fires The undeclared war in China has given an opportunity to observe the practical part that fire fighters play during modern hostilities. Our member, Chief Officer J. Gordon Dyson of the Shanghai Fire Brigade, sent with his Christmas card a report of the activities of the brigade during the lively month of August. The strange psychology that makes people have the same general attitude toward warfare as toward electric storms seems to have prevailed in the department, as it went about its usual and extraordinary duties with calmness and direction.

Let's glance at the record: On August third a typhoon which blew at 82 miles an hour caused 19 fires and sent ambulances scurrying to 27 locations. "The climax of a strenuous day took the form of a serious fire in the Ting Kong Native Bank Godown." (A godown is a warehouse, not an escalator—Ed.) "Fanned by the typhoon, raging at the time, and aided by the interior construction of the godown, which was of wood, and the inflammability of the contents, comprising mostly silk cocoons, the fire spread very rapidly and in a short time the whole building was well alight." Five hours of fighting put the blaze into the records and the godown into ashes.

But Zeus was merely giving a smattering of an idea of what Thor was to bring. On August 13, and from then on, Japanese bombs fell on Shanghai. On the 14th the brigade was called to a point where two aerial bombs had struck

hotels. "A large number of dead (729) and injured (861) persons were found to be lying in the street." The living were rushed to the hospitals, the dead extricated from the ruins. A few moments later the brigade was on its way to another bombarded section, this time a busy market area. Its members found over a thousand dead and another thousand injured, while twenty automobiles burned in the street. The fires were extinguished, while the ambulances and every other available conveyance were used to help the victims. In the whole month, fifty fires started by the warfare were extinguished by the brigade, and the victims cared for. Says the report, regretfully, "Numerous extensive fires broke out in Wayside and Yangstzepoo round about August 20, but constant heavy shelling and fighting in those areas made it impossible for the brigade to attend."

Through all this, the firemen were continually busy trying to save themselves and their apparatus from being blown off the map. Four Japanese field guns forced the evacuation of a station on August 13. On the 17th, the men of one station left just before a shell entered. Another division decided to leave before one of the shells that had been missing all night long scored a hit.

That's the way the Shanghai fire department bore out the N.F.P.A. idea of a fire department's importance in time of war. Even though the fire damage was tremendous in spite of them, the brigade saved an untold amount in lives and property. Its ambulance and first aid service did much to reduce the horror of aerial warfare.

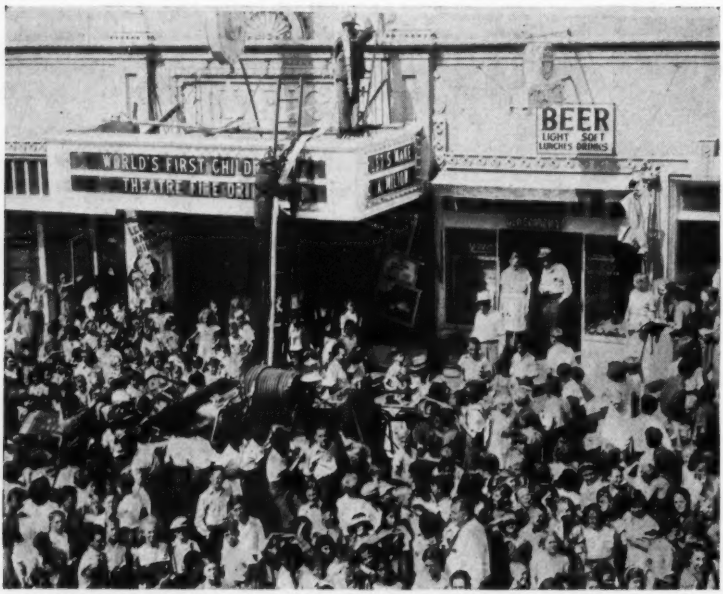
A Christmas card sent to the N.F.P.A. by Chief Officer J. Gordon Dyson of the Shanghai Fire Department.

Theatre Fire Drill, Bisbee, Arizona.

As part of the observance of Fire Prevention Week, the Lyric Theatre in Bisbee, Arizona, last October held the first audience fire drill to be reported to the N.F.P.A. At the announcement of the drill, twelve hundred children filed quickly out of the theatre in orderly ranks. The building was emptied in 3:47 minutes.

Program for the Drill.

The drill was planned by Mr. DeGrazia, manager of the theatre, in co-operation with the Fire Prevention Committee of the Bisbee Chamber of Commerce. Since it was aimed mainly at the education of the children, a special Saturday morning matinée was planned, during which the drill would be run. Publicity was circulated that would induce as many children as possible to attend. There were attendance prizes. A specially low admission was charged for the performance. Special announcements were made in the city



Children standing in front of the theatre which they have just vacated in a fire drill, watching the fire department go through the operations of fire fighting. This fire drill, the first in America, was held as a feature of Bisbee's Fire Prevention Week program. The theatre was emptied in less than four minutes.

schools. The picture that was to be shown was chosen to lure the children, and was praised in the local papers. All parents were assured that the affair would meet with their full commendation.

The drill itself was publicized not under its own name, but as "A surprise feature believed never before presented in the United States." Speaking of it, the papers said, "Coöperating with Fire Prevention Week, the theatre offers an exclusive presentation in keeping with the spirit of the national program. Members of the fire department and the police department of the city will collaborate. Children attending the show will be given an opportunity to assume a first place in a national program, which the theatre is originating."

The drill came off as planned and was very successful. The dramatization was complete when the Bisbee Fire Department rolled to the theatre with a hose truck and attacked an imaginary fire. They swarmed over the buildings on ladders, giving the children an instructive and entertaining performance.

The event attracted much favorable comment. It was executed by the management with laudable competence. The Bisbee theatres now plan to hold such a drill every year during Fire Prevention Week.

The N.F.P.A. has long advocated the instruction of theatre employees in the proper way of handling the crowd when a fire alarm sounds. If this public drill makes no lasting impression on the children of Bisbee, it has at least been the means of teaching the theatre attendants a practical, working manner of emptying the theatre in case of emergency.

The 1937 U. S. Fire Loss.

The preliminary estimate of the fire loss in the United States for the year 1937 is $284,547,142. This amount is based on estimates compiled by the National Board of Fire Underwriters for the first eleven months of the year, with a figure for December based upon loss experience for the same month in previous years. This total estimate is approximately nine million dollars less than the 1936 preliminary loss estimate.

Comparative Monthly Loss Estimates, 1935, 1936, 1937.

	1935	1936	1937
January	$23,430,504	$27,729,930	$25,069,895
February	25,081,625	30,909,896	28,654,962
March	24,942,703	29,177,406	29,319,029
April	23,267,929	25,786,835	26,663,854
May	21,238,205	21,479,380	21,437,739
June	18,499,675	20,407,485	19,524,765
July	19,293,619	22,357,020	19,812,485
August	18,137,060	21,714,495	19,767,314
September	16,641,882	20,413,537	19,349,756
October	19,785,871	20,439,136	21,097,670
November	20,871,584	20,808,497	23,849,673
Total 11 months	$232,190,657	$263,223,617	$254,547,142
December	21,969,288	30,133,628	30,000,000*
Total 12 months	$259,159,945	$293,357,245	$284,547,142
Adjusted loss figures (Released later in year.)	$235,263,401	$263,259,746	

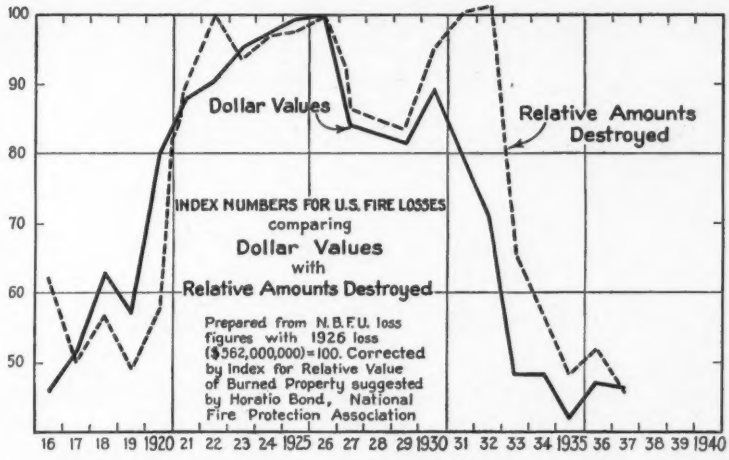
It may be noted that the final loss figures for both 1935 and 1936 are less than the preliminary loss figures for those years. It may be assumed, therefore, that the adjusted loss figure for 1937 will also be lower than the preliminary estimate.

Aggregate Loss for 22 Years Is Approximately Nine Billion Dollars.

The 1937 fire loss brings the total fire waste of the United States during the past twenty-two years up to $8,960,217,880, which is an annual average of about 407 million dollars. The following table gives the annual fire losses by years since 1916.

1916	$258,377,952	1927	$472,933,969
1917	289,535,050	1928	464,607,102
1918	353,878,876	1929	459,445,778
1919	320,540,399	1930	501,980,624
1920	447,886,677	1931	451,643,866
1921	495,406,012	1932	406,885,959
1922	506,541,001	1933	271,453,189
1923	535,372,782	1934	271,197,296
1924	549,062,124	1935	235,263,401
1925	559,418,184	1936	263,259,746
1926	561,980,751	1937 (Est.)	284,547,142

*December figure is estimated on the basis of previous years.


100
90
80
70
60
50
Dollar Values
Relative Amounts Destroyed
INDEX NUMBERS FOR U.S. FIRE LOSSES
comparing
Dollar Values
with
Relative Amounts Destroyed
Prepared from N.B.F.U. loss figures with 1926 loss ($562,000,000)=100. Corrected by Index for Relative Value of Burned Property suggested by Horatio Bond, National Fire Protection Association
16 17 18 19 1920 21 22 23 24 1925 26 27 28 29 1930 31 32 33 34 1935 36 37 38 39 1940

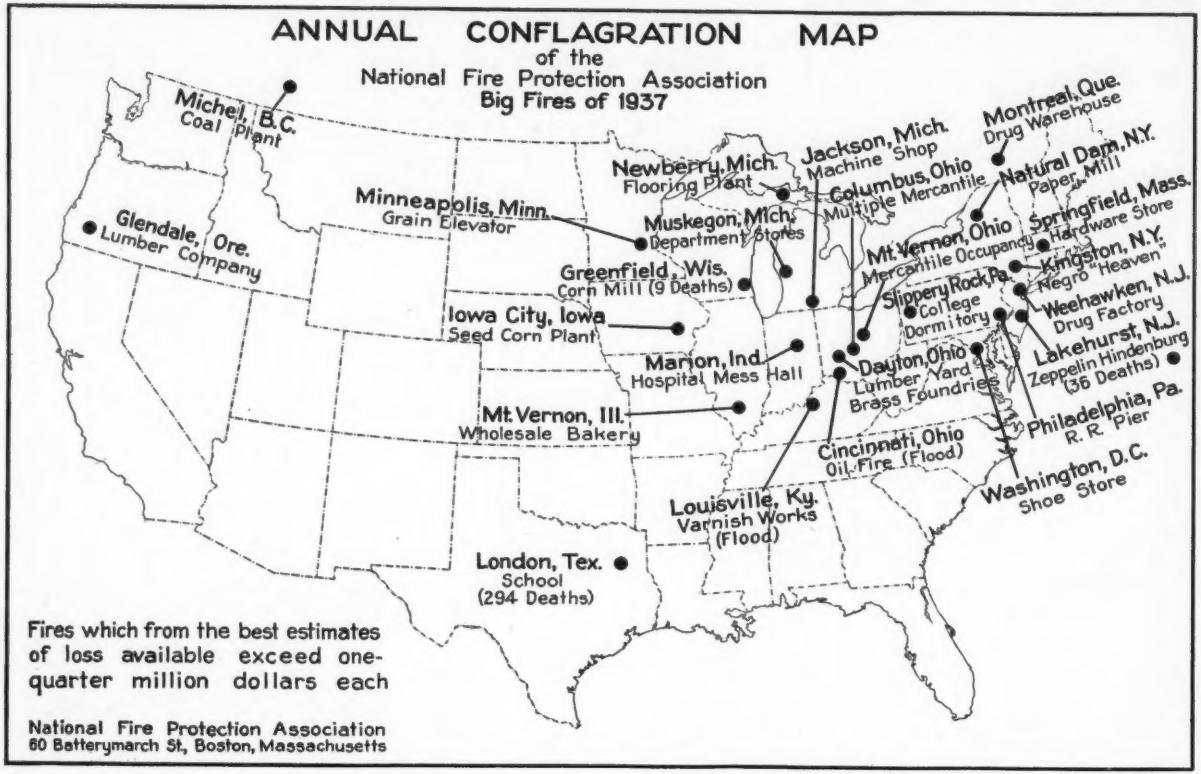
Dollar values of U. S. fire losses, almost uniform for the past five years, are still declining sharply, if expressed in terms of the relative amount burned. The Index for Relative Value of Burned Property used in preparing the above chart is an arithmetical average of the Index of Wholesale Prices of the United States Bureau of Labor Statistics and the Engineering News-Record Construction Cost Index (1926 = 100).

Large Loss Fires, 1937.

During the year 1937 there were reported to the N.F.P.A. Department of Fire Record twenty-three fires in the United States involving a loss estimated at $250,000 or more each. This is a decrease of nineteen fires over 1936, and is the lowest number since 1933, when there were twenty-two such fires. During 1937 there were two fires in this classification in Canada, which compares with one fire in 1936.

The locations of the twenty-five large loss fires are shown on the accompanying annual conflagration map. It is interesting to note that all but two of the twenty-three fires in the United States occurred in the Northeastern quarter of the country. This is not the experience of previous years; in 1936, for example, only about one-half the fires occurred in the Northeastern quarter.

Three fires caused losses in excess of $1,000,000, and seven fires caused losses of $500,000 or more. The largest loss of the year was the Zeppelin *Hindenburg* disaster, which also took thirty-six lives on May 6. In addition to being a large loss fire in the monetary sense, the London, Texas, school disaster took 294 lives; the largest loss of life in a single fire during 1937. Nine lives


ANNUAL CONFLAGRATION MAP
of the
National Fire Protection Association
Big Fires of 1937
Michel, B.C.
Coal Plant
Glendale, Ore.
Lumber Company
Minneapolis, Minn.
Grain Elevator
Newberry, Mich.
Flooring Plant
Muskegon, Mich.
Department Stores
Greenfield, Wis.
Corn Mill (9 Deaths)
Iowa City, Iowa
Seed Corn Plant
Marion, Ind.
Hospital Mess Hall
Mt. Vernon, Ill.
Wholesale Bakery
London, Tex.
School
(294 Deaths)
Louisville, Ky.
Varnish Works
(Flood)
Cincinnati, Ohio
Oil Fire (Flood)
Jackson, Mich.
Machine Shop
Columbus, Ohio
Multiple Mercantile
Dayton, Ohio
Lumber Yard
Brass Foundries
Montreal, Que.
Drug Warehouse
Natural Dam, N.Y.
Paper Mill
Springfield, Mass.
Hardware Store
Mt. Vernon, Ohio
Mercantile Occupancy
Kingston, N.Y.
Negro "Heaven"
Slippery Rock, Pa.
College
Dormitory
Weehawken, N.J.
Drug Factory
Lakehurst, N.J.
Zeppelin Hindenburg
(36 Deaths)
Philadelphia, Pa.
R.R. Pier
Washington, D.C.
Shoe Store
Fires which from the best estimates of loss available exceed one-quarter million dollars each
National Fire Protection Association
60 Batterymarch St., Boston, Massachusetts

were also lost in the second largest loss fire — the mill explosion and fire in Greenfield, Wisconsin, on April 10.

A summary of each of the twenty-five fires is presented below to show the factors responsible for each large loss as far as the information is available. The loss figures in most instances are adjusted figures or authoritative estimates.

January 24, Cincinnati, Ohio, Conflagration. Loss: $1,225,000.

Fire occurred during the Ohio River Flood. Ordinary means of fire fighting were futile because of the flood waters and the burning gasoline floating on it, which was released from tilted storage tanks. Fire was believed to have resulted from a short circuit in a broken power line falling against some object and into the water, which was covered with gasoline. Several frame residences were quickly enveloped, then gasoline storage tanks of the Standard Oil Company exploded in rapid succession. Flames leaped to a height sufficient to break most of the wired glass in the metal sash on one side of an eight-story reinforced concrete building of the Crosley Radio Corporation. In addition a dozen other buildings were destroyed. (April, 1937, QUARTERLY, page 346.)

January 26, Louisville, Ky., Louisville Varnish Company. Loss: $265,000.

Fire occurred during the Ohio River Flood. Naphtha tanks in yard were lifted by flood waters, breaking connections and releasing naphtha, which was probably ignited by boiler fire. Public water supply was out of commission and sprinklers quickly drained gravity tank. Fire department could not reach plant, and all buildings and contents were destroyed. A brick wall and building walls prevented spread of naphtha beyond yard limits and little damage was done to surrounding property. (April, 1937, QUARTERLY, page 337.)

January 29, Newberry, Michigan, Robbins Flooring Company. Loss: $250,000.

Fire started in frame monitor of flooring mill where considerable dust had accumulated. It spread rapidly to the stock building, dry kiln, and lumber shed. The fire department did not arrive until about twenty minutes after the alarm was first sounded, and then only one piece of apparatus was available. One hose line which was being used effectively in saving the dry kiln, burst, and while the pumper was shut down for a few minutes the fire got a head start in the dry kiln. The combustible character of the buildings and contents and a strong wind also were responsible for the rapid spread and large loss.

January 30, Mt. Vernon, Ill., Consolidated Biscuit Company. Loss: $250,000.

Fire started in skeleton iron-clad warehouse addition and upon arrival of fire department the fire had gained such headway that it was useless to try to save it. Fire spread to main fire-resistive building and firemen were severely handicapped by the lack of ladders to reach the third and fourth floors. Water supply from hydrants on one street was poor. Fire-resistive building was severely damaged by exposure and section which had wooden roof was totally destroyed.

February 6, Muskegon, Mich., Mercantile Block. Loss $400,000.

A mercantile block occupied by two large dry goods and department stores, with professional offices and apartments on part of the upper floors, was destroyed by fire which started in the basement. Practically all floor openings formed by elevators and stairways were unprotected. The buildings formerly consisted of three separate divisions separated by fire walls, but within the past year unprotected openings had been made in these brick walls. The large loss was largely due to these wall openings, to the headway of the fire when discovered, and to the lack of automatic sprinkler protection. (April, 1937, QUARTERLY, page 367.)

March 14, Springfield, Mass., Carlisle Hardware Company. Loss: $275,000.

Fire started simultaneously in a three- and six-story hardware building and a six-story warehouse across the alley. The fire had gained considerable headway when discovered by a police officer about four o'clock on Sunday morning. Poor construction, open stairways and elevator shaft, and lack of automatic sprinkler protection were factors contributing to the large loss.

March 14, Jackson, Mich., Thorrez and Maes Manufacturing Company. Loss: $340,000.

Plant engaged in making screw machine products. Sawdust was used beneath machines to absorb oil; and the floor, machines, and surroundings were badly oil soaked. Watchman tried to extinguish fire before turning in an alarm, during which time the fire gained considerable headway. In addition to oil soaked sawdust and the improper storage and use of flammable cutting oils, large fire areas with wooden roof of light construction and poor public water supply were responsible for the rapid spread of the fire and the resultant large loss.

March 18, London, Texas, High School. Loss: $300,000, and 294 Lives.

An explosion due to leaking gas from a pipe or pipes under the building being ignited from the arc of an electric switch resulted in the death of 294 school children and teachers. No fire followed the explosion, presumably due to the small amount of combustible material. The building was of good construction, but had an excessive area of concealed space under the main section, where the destructive gas is presumed to have accumulated. The gas installation was faulty. (April, 1937, QUARTERLY, page 299.)

March 31, Marion, Ind., Mess Hall of Veterans' Hospital. Loss: $300,000.

The kitchen was all aflame when discovered shortly after midnight. Old two-story building of ordinary brick construction with wooden floors. Unprotected stairways from basement to second floor. The fire spread rapidly and the entire structure was destroyed. It was owned by the Federal Government and was uninsured.

April 4, Montreal, Que., Drug Warehouse. Loss: $328,000.

Fire started in the basement from some unknown cause. The building was used largely as a wholesale drug warehouse, with sorting and packing operations. In addition to nearly total destruction of the building and contents, considerable damage was done to neighboring property.

April 10, Greenfield, Wis., Krause Milling Company. Loss: $1,250,000, and 9 Lives.

A dust explosion in the basement or first floor of a modern fire-resistive mill building and the fire that followed destroyed about half the plant and took nine lives. This explosion apparently caused two lesser explosions to follow. Most of the damage was done by the explosions, but fire practically destroyed several sections of the plant. Portions of the sprinkler system were disrupted, enabling the fire to get a good start, and in other sections sprinklers were handicapped by the large number of heads that were fused by the heat waves from the explosions. The explosion wave passed through an underground tunnel to another group of buildings and upward through elevator legs and other openings. Much machinery was constructed of combustible materials. (July, 1937, QUARTERLY, page 59.)

May 5, Natural Dam, N. Y., Rushmore Paper Company. Loss: $450,000.

An overheated bearing ignited paper in a paper machine and flashed rapidly over paper dust and spread to loose paper on the machine, which had not been cleaned for some time. No fire extinguishers were quickly available because they had not been recharged after use at a small fire caused by the same bearing the day before. Sprinklers opened, but apparently the gravity tank which supplied them was empty or nearly empty. A 25-mile wind helped spread the fire to the adjacent finishing building.

May 6, Lakehurst, N. J., Zeppelin Hindenburg. Loss: $3,750,000, and 36 Lives.

The German Zeppelin *Hindenburg* burst into flames near the tail while landing and within one minute it was completely destroyed. The flammable hydrogen gas with which it was filled was responsible for the rapid spread of the fire. Thirty-six of the 109 persons aboard lost their lives. (July, 1937, QUARTERLY, page 53.)

June 15, Dayton, Ohio, Group Fire. Loss: $300,000.

A fire of conflagration proportions practically destroyed the lumber yard of a box factory and two brass foundries. Other industrial property was damaged, and several city blocks were threatened. The large amount of combustible construction, a strong changeable wind, and the intense heat of the fire seriously handicapped the firemen. There were large areas of undivided and unprotected frame construction. (October, 1937, QUARTERLY, page 147.)

August 14, Philadelphia, Pa., Railroad Pier. Loss: $335,000.

This Pennsylvania Railroad pier was 567 feet long, 185 feet wide, constructed of timber piling overlaid by a wooden deck, and was used as a transfer and delivery pier and also for the storage of unclaimed freight. The shed was one story high, with corrugated iron sides on an iron frame. The fire started in unclaimed freight near the outboard end of the pier, and apparently had been burning long before it was discovered. It had gained great headway when the fire department arrived. The rapid spread of the fire was due to the combustible character of the construction and contents and the unbroken roof area. Draft conditions occasioned by the end doors being open and the side doors closed also assisted in the rapid spread of the fire. The pier was not sprinklered. (October, 1937, QUARTERLY, page 143.)

Pictures, Inc.

The $250,000 fire at the Ingram Lumber Company in Glendale, Ore., on August 20, 1937. The nearest fire department, 30 miles away, had to wait 50 minutes for authorization before starting to the fire. Due to the arrangement of the buildings, the plant fire protection equipment, and the work of firemen, the fire was prevented from spreading to the adjoining sawmill and the large lumber yard.

August 20, Glendale, Ore., Ingram Lumber Company. Loss: $250,000.

Fire started in a dry lumber shed and quickly involved several planing mill buildings adjoining it. About two and one-half million feet of lumber were in the sheds. Employees were assisted in fighting the fire by four men and a pumper from Grants Pass, but it was more than one and one-half hours before they arrived, because authorization to respond had first to be obtained and it was a 30-mile run. By this time the mill buildings had burned and the dry kilns were burning. The humidity was low and a light wind carried heat to spread the fire.

September 15, Weehawken, N. J., S. B. Penick and Company. Loss: $600,000.

An explosion, apparently of flammable vapors, occurred in the basement of a drug plant, which was mainly of brick mill construction. This explosion probably stirred up deposits of dust resulting from grinding and sifting processes, causing a series of explosions. Within three or four minutes the entire building was in flames, which soon spread through wall openings where fire doors apparently did not operate — possibly due to the floor being raised by the first explosion. Fire also spread rapidly to upper floors through conveyor openings, aided by dust explosions and feeding on the storage of finely divided drugs. The fire was not controlled by sprinklers because the initial explosion broke the feed pipe in the basement. The intense heat and heavy smoke hampered the firemen. The entire plant, covering a ground area of about 37,000 square feet, was destroyed with the exception of a two-story section.

September 28, Minneapolis, Minn., Delmar Elevator. Loss: $600,000.

At 9:30 in the evening while the elevator was in operation three employees on the ground floor heard a small explosion and almost at once saw flames coming out of the top floor windows. Shortly after the fire department arrived a much larger explosion blew the roof off the elevator. It was evident from the start that little could be done but protect exposed buildings. The elevator was of frame iron-clad construction, one to seven stories high, with a capacity of 500,000 bushels. It was not sprinklered, and was practically full of barley. The fire quickly reached such proportions and intense heat that a general alarm was given, bringing over 350 firemen. Sixteen pumpers worked for an average of seven hours each and over 35,000 feet of hose were used, but the fire department was handicapped by the lack of sufficient hydrants and adequate water mains. Insufficient roadways made some parts difficult to reach with fire apparatus. In spite of these difficulties the department was successful in confining most of the loss to the elevator.

October 15, Slippery Rock, Pa., State Normal School. Loss: $500,000.

Historic North Hall, principal women's dormitory, burned to the ground within a few hours after the fire started in the kitchen at 5:20 A.M. The building was brick veneered, three stories high, with no fire stops between the floors, allowing the fire to burn in the concealed space between the sheathing and brick wall, and to go from the kitchen to the roof without hindrance. By the time the fire was discovered burning in this concealed space it had gained such headway that it was beyond control of the volunteer fire company. Firemen concentrated their efforts to save surrounding buildings.

October 25, Michel, B. C., Crow's Nest Pass Coal Company. Loss: $369,000.

A fire started in the boiler room of this coal handling plant and was discovered at 2:05 A.M., when it broke out of a hot air duct through which it had been traveling. When the first alarm was sounded only nine firemen were available. Fire fighting equipment consisted of one pumper and one line of hose. This lack of sufficient equipment and the presence of large amounts of coal dust and gases were factors contributing to the total destruction of the plant.

October 31, Mt. Vernon, Ohio, Mercantile Buildings. Loss: $300,000.

Fire, starting in the basement of the F. W. Woolworth store, destroyed the 3-story building, the 4-story adjoining building, and much of a third building four stories high. All three buildings had open stairways. Firemen experienced considerable difficulty in their efforts to reach the seat of the fire. Improperly constructed fire walls and parapets, and unprotected floor openings were factors contributing to the rapid spread of the fire. The fire department was insufficiently manned and inadequately equipped to cope with such a serious fire. The buildings were not equipped with automatic sprinklers. (January, 1938, QUARTERLY, page 222.)

November 7, Kingston, N. Y., Eighty-Room Mansion. Loss: $300,000.

Sparks from a fireplace chimney ignited the wooden shingle roof of this once imposing structure, which was being occupied as "heaven" of the negro

International.

This intense fire in a drug plant in Weehawken, N. J., on Sept. 15, 1937, started from an explosion in the basement, which also broke the main sprinkler pipe, crippling the private fire protection of the plant. The plant was practically destroyed and considerable damage was done to near-by tenement buildings and an office building. The loss was $600,000.

cult leader, Father Divine. Before firemen could run hose lines to this secluded spot, nothing remained but smouldering ruins.

November 16, Columbus, Ohio, Mercantile Buildings. Loss: $750,000.

Fire, starting in the basement of the F. W. Woolworth store, quickly spread to all five floors and communicated to the adjoining 4-story F. and W. Grand store. Both buildings were of ordinary wood-joisted brick construction, with unprotected floor openings. The fire had gained such headway when discovered that it quickly worked its way through the upper floors. Brick division walls in both buildings were ineffective, since they were supported on the first floor by unprotected or poorly protected iron columns. (January, 1938, QUARTERLY, page 223.)

December 12, Washington, D. C., Hahn Shoe Store. Loss: $400,000.

The fire which started in the basement of the store on Sunday morning probably burned for several hours before it was discovered. When firemen arrived the flames in the basement were beginning to break through to the first floor. The building was four stories high, of ordinary brick construction, and

was occupied entirely for retail shoes. Due to the construction of the building and the headway of the fire when discovered, the building was gutted. There was no sprinkler system. Considerable smoke and water damage was done to Christmas stocks in the adjoining Goldenberg Department Store. (See Frontispiece.)

December 12, Iowa City, Iowa, Hybrid Corn Company. Loss: $250,000.

When the fire in this seed corn plant was discovered at 3:30 P.M. on Sunday flames were already visible at several windows. The building was well involved when the fire department arrived with its two pumpers. The building was three stories high, of heavy wood-joist construction, with brick walls, undivided floor areas of 13,000 square feet in each story, and unprotected openings in all floors. Two hydrants on 6-inch dead-end mains were available, but the water supply was limited to three hand lines. Automatic sprinkler equipment covered the entire plant, but was out of service at the time of the fire. Both gravity and pressure tanks had been removed and the sprinkler equipment was not connected to a water supply, and no fire department connection was provided. The entire building and the contents of 45,000 bushels of shelled corn were destroyed. In addition to the delay in discovery, the construction, large concentration of values, and limited water supply, a strong wind was a factor contributing to the large loss.

Factors Responsible for the Large Losses.

Several factors were responsible for the large loss in most of the twenty-five large loss fires in 1937. In only a few cases, such as the Zeppelin *Hindenburg* disaster, in which flammable hydrogen gas was responsible for the almost instantaneous destruction of the ship, can only one reason be assigned as the main contributing factor. The accompanying table indicates the frequency of the most important factors responsible for the losses running to $250,000 or more each.

As usual, "inferior construction" and "highly combustible contents" are the two factors most frequently noted by an analysis of the reports of these twenty-five fires received by the N.F.P.A. Department of Fire Record. Next in order are "lack of adequate private protection," "unprotected vertical openings," and "headway of fire when discovered."

These large losses might have been prevented or extinguished in their incipiency had adequate preparation been made beforehand. The following table indicates, and the foregoing summaries bring out in greater detail, that recognized fire prevention and fire protection rules had largely been disregarded. With little or no means to detect or extinguish a fire before it gets a head start, with plenty of combustible material to feed upon, and with but little provision in the way of construction features to confine a fire to a reasonably small area, even the best equipped fire department is handicapped in its efforts to prevent complete destruction. A little forethought and expense

certainly would have been profitable investments in most of these cases where values of $250,000 or more were involved.

A study of the times of day that these fires occurred shows that the 8-hour period from 4 A.M. to noon on Sundays is the most likely time for large loss fires, as five of them occurred during that time. Twelve, or one-half (no information was available as to the time of one fire), of the fires occurred during Saturday or Sunday, generally when there was the least business activity. This continues the trend of previous years and seems to indicate that fires which start during greatest business activity are detected and extinguished before becoming large losses, while those occurring during periods of decreased activity are more likely to spread beyond control before being detected.

Reasons for Large Loss.

		No. of Fires
Structural Factors		34
Inferior construction, excessive areas, etc.	15	
Unprotected vertical openings	9	
Lack of sufficient exposure protection	5	
Wooden roofs	3	
Wooden shingle roofs	1	
Unvented space under floor; gas accumulated	1	
Occupancy Factors		25
Highly combustible contents, excessive amounts of burnable stocks	13	
Spread of flames enhanced by accumulations of dust	6	
Flammable liquids	3	
Flammable liquids released during floods	2	
Faulty installation of gas piping and heaters	1	
Fire Protection		22
Lack of adequate private protection	11	
Lack of fire doors or cut-offs between sections	3	
Lack of adequate public protection	3	
Sprinkler system overtaxed by flood conditions	2	
Sprinkler system disrupted by explosions	2	
Explosion raised floor, preventing operation of fire doors	1	
Fire Fighting		17
Fire difficult of access for fire fighting	5	
Fire department inadequately manned or equipped	4	
Inexperience in fighting fires of such magnitude	2	
Flood waters hindered fire fighting	2	
Fire department delayed	2	
Failure of private protection	1	
Hose line burst	1	
Water Supplies		11
Inadequate water supplies	5	
Shortage of hydrants	3	
Water supplies failed because of flood	2	
Too far to water supply	1	
Delays in Giving Alarm		9
Headway of fire when discovered	8	
Effort made to extinguish fire without giving alarm	1	
Explosions		5
Strong wind		4
Hydrogen gas (Zeppelin *Hindenburg*)		1
Low humidity		1

The Forest Fire Season of 1937.

By Roy Headley,
Chairman, N.F.P.A. Forest Committee.*

A new all time record for fire control on the national forests has been set in 1937. Losses in area to December 10 amounted to 500 acres per million acres protected. The best previous record was in 1933, when losses were held to 800 acres per million. While no figures are available as yet for state and private forests, it is known that the season has been favorable and the losses low.

Nineteen thirty-seven has been a year of easy fire weather, of course, and is only comparable with other easy years. There are, however, some significant things to be learned by comparison of results attained in easy forest fire years. Viewed statistically, it is harder to improve loss records for easy forest fire years than for those of really tough fire weather. In 1906, when forest protection in the modern sense was not even organized, losses on the national forests were held to 1000 acres per million protected. Not until 1930 was this record bettered. Nineteen thirty-three showed a slight gain over 1930, and 1937 losses of area less than three-fourths of the loss for 1933.

In contrast to this the records for the definitely unfavorable fire seasons show a rapid and fairly well-sustained decline. The first really bad year after the creation of the national forests was 1910. Losses of area amounted to over 25,000 acres per million that year. Succeeding years which are recognized as presenting highly unfavorable weather conditions are 1919, 1924, 1926, 1929, 1931 and 1934. Losses for these years show a generally downward trend, ending with a loss of 3200 acres per million in 1934.

Foresters generally recognize that most of their fire losses will occur in the one or two bad fire weather years which we have come to expect in each half decade. Attention and effort are therefore focused on means of curtailing losses in such years. The betterments in facilities and management which have made it possible to reduce losses in bad years might be expected to carry over into the easy and normal years and produce more reduction of losses than has been experienced. The fact remains, however, that loss ratios in easy years have not improved to any marked degree.

Man Caused Fires.

One of the gratifying aspects of the 1937 fire season is the reduction which has taken place in the number of man caused fires on the national forests. In 1936 up to December 10 a total of 11,141 man caused fires had

*Mr. Headley is Chief of the Division of Fire Control, U. S. Forest Service.

occurred. In 1937, to the same date, only 6061 had occurred — a reduction of 46%. If this reduction could all be attributed to the zeal and effort which have been put into fire prevention we would have abundant cause for congratulation and rejoicing. The increasing wave of interest and activity in forest fire prevention undoubtedly has had something to do with it, but the main reasons for the better showing have been that the 1937 fire season has been shorter than in 1936, moisture contents of forest fuels have not gone as low and winds have not been as unfavorable.

The major portion of the reduction in number of such fires occurred in the national forest regions east of the Great Plains. These regions in 1936 reported a total of 8116 fires due to human agencies, against a corresponding total of 3626 for 1937. Inclusion of additional area in the national forests of these eastern regions beginning in 1933 caused the total of national forest man caused fires to jump from 1278 in 1933 to over 8000 in 1936.

The Blackwater Fire.

The most disastrous experience of 1937 occurred in Wyoming on the Shoshone National Forest, where forest fire danger is normally so low that no

Aerial view of Blackwater burn. Dash line indicates edge of fire when finally corralled. Dotted line shows fire line lost at time of tragedy. Right-hand arrow marks the place where 7 men were burned to death by a spot fire from below, which these men had just discovered when fires were whipped to fury by sudden wind. Left-hand arrow points to spot on ridge where crew of 40 men were overtaken by flames while climbing to safety above timber line. Most of the crew who stayed with their foremen at this point were painfully burned. Three died later. Four others who broke away died in the fire.

organized system of lookout stations and other protection facilities is maintained. These areas of average low danger do, however, have periods when fires will ignite and spread with vicious power. During August a lightning fire started on this national forest and spread with unusual rapidity because of low atmospheric moisture. During the second day of the work on the fire, high and erratic winds occurred with explosive suddenness. If these winds had occurred a few hours earlier or a few hours later there probably would have been no loss of life. The relative timing of the freak winds, the showing up of a detached fire started by a spark from the main fire and the position of the crews as they pushed their fire lines ahead, produced a fatal combination. Fifteen men were burned to death or died later from their injuries and 38 others were seriously injured.

Forest fires readily inspire terror. The "crowning" of a fire in a clump of trees or even in a single tree makes a roar to which even veterans are seldom insensible. One of the acute problems of fire fighting foremen is to keep crews from panic when fires assume menacing characteristics. In this instance a few members of crews broke from the control of their foremen and most of these died as a result; but most of the men obeyed their leaders, which served to prevent a much worse loss of life.

Not since 1910 have so many lives been lost on a single national forest fire. The fact of the matter is that statistically speaking the danger of being burned in fire fighting is surprisingly low. More than 100,000 men are probably employed for short periods in forest fire fighting in the average year, but accidents from burning are rare. In most years more lives are lost from rolling rocks and falling snags than from burns.

Complete safety is not to be expected in fire fighting. When human agencies grapple with powerful and variable forces, such as wind and the processes of combustion in forest fuels, some accidents are bound to occur. In the case of this fire a combination of adverse physical factors produced a situation seldom encountered, and a disaster resulted. The responsible officers could not have foreseen the interplay of these factors. The regrettable loss of life is properly viewed as only one of the infrequent mishaps which must be expected.

The Cost of Safety in Wiring.

By L. W. Going,
President, International Association of Electrical Inspectors.
(Member N.F.P.A.)

As we look forward to another Association year in this era of rapid progress in the electrical arts it will be to our advantage if we pause for a moment and consider one of the major problems which is today confronting the electrical industry and give serious thought to the possible ways in which our organization may render assistance in the solution of this problem. The problem to which I refer is the future development of the National Electrical Code to keep pace with the swiftly moving changes in industry needs.

The chief object of our Association is to bring about the uniform interpretation and application of the National Electrical Code. The extent of our Association's contribution in the development of electrical codes and standards is determined by the soundness of our policies and is predicated upon our ability to foster uninterruptedly such activities in these matters as are consistent with the purpose and objects of our organization.

Our Association stands for progress in the art of wiring and I believe you will agree that this can result only by the adoption of minimum standards that are based on performance and which have liberal safety factors when applied to the character of the materials in question, and as related to the conditions of use or operation. We do not believe that progress can result from adding constantly to the Code more and more wiring methods and materials which are less safe, or cheap substitutes for those safe methods and materials which have stood the test of time.

It would seem that the Code now contains an ample variety of wiring methods and that little if any economy can be effected by further multiplication of an already top-heavy situation. If industry is more interested in wiring economy than in wiring stability why not spend a little less effort on the development of new wiring methods and a little more effort in pushing some of the present methods which have been blessed by the Code, but are still largely barred from use by municipal wiring ordinances?

It is our opinion, however, that practical economy in wiring costs will be brought about more quickly if industry will encourage standardization of wiring materials with opportunity for mass production and consequent reduction in price and will discourage the introduction of needless varieties in materials and methods, all of which tend to make wiring more complicated and costly.

Extracted from Mr. Going's Presidential Address presented to the 1937 Annual Meetings of the Sections of the International Association of Electrical Inspectors.

This year, on its fortieth anniversary, the Code appears in a completely revised form which, because of the grouping of related requirements, will be much easier to use not only by the inspectors who must enforce it, but also by that very extensive group who must comply with its requirements.

One feature of the new 1937 Code which is of immediate interest to the industry and to the inspector is the introduction in Article 210 of minimum requirements in dwelling occupancies for branch circuit layout. The new requirements are intended to provide a reasonable efficiency and convenience in the use of electric service in the home and to avoid the necessity for major changes in wiring capacity following the completion of the installation. At the same time consideration has been given to economy of installation by requiring only a sufficient number of branch circuits to provide for the normal consumption of electrical energy in each room in the house with a small margin of capacity to care for unusual or abnormal demands. While the new provisions in Article 210 are based upon reasoning which is fundamentally correct, it should be kept in mind when using the rules that they are minimum safe wiring requirements, rather than standards of adequacy, and are intended to set a lower limit below which competitive wiremen dare not go.

It is unfortunate that progress toward adequate wiring has been retarded largely because industry has failed to successfully sell the idea to the public and has instead placed too much dependence upon the minimum provisions of the Code and upon the services of the electrical inspector to guarantee the consumer that his wiring installation was satisfactory and safe. There has been, and, I am afraid there still is, a too common attitude on the part of industry, or at least certain representatives of the utility group, to accept without questioning the impression that progress toward adequacy in wiring is being retarded because of unnecessary and restrictive Code rules. This impression is so general that I am submitting here some figures on wiring costs which will, I believe, largely discredit the idea that wiring expense can be materially reduced through Code recognition of questionable wiring methods.

Cost of Wiring.

In any analysis of wiring costs it should be evident that only a part of the total wiring cost is dependent upon the type of wiring method employed, and that the major part of the cost is fixed by other factors, such as the cost of material and labor for installation of service equipment, distributing panel, outlet boxes, switches, plug receptacles, finish plates, etc., plus the contractor's overhead and profit.

Let us consider, for example, the wiring of a six-room residence equipped for electrical range and having a total of 50 light, switch and receptacle outlets connected. The total cost of this wiring installation in the city of Portland, Oregon, today will not exceed $130.00, including contractor's overhead

and profit. This estimate is based upon present day costs of materials, with labor at $1.25 per hour, and includes in addition to the range and light wiring, the installation of door bell equipment and radio outlet.

The customer pays a total of $130.00 for this job, which is distributed as follows: material, $62.49; labor $26.94; contractor, $40.57. In other words, the manufacturers' stake, including the distributor's cost in this installation, amounts to 48 per cent of the total; labor's stake amounts to 21 per cent, the contractor's stake amounts to 31 per cent. If anybody has a complaint coming on that set-up, I think it is labor.

Now, of course, the power company has no direct stake in the wiring installation except that it wants an adequate service and wants to sell kilowatt hours. I might mention, however, that the material for the service on this particular job cost $13.96, or almost one-quarter of all the material used on that job. I don't believe that even our utility friends would begrudge that expenditure, because they have an ironclad, tamper-proof service, with plenty of capacity. It will never have to be changed.

As we are primarily interested in that part of the wiring cost which may vary with the type of wiring method employed, let us consider the labor and material cost for installing branch circuit runs between distributing panel and outlet points. For the installation under discussion the labor and material cost for installing the lighting and appliance circuits amounts to $32.00 and, for the range circuit, $9.00. This makes a total of $41.00, or about 31% of the total wiring cost, which is dependent upon the type of wiring method employed.

The Cheapest Wiring Method.

Let us see how much of a saving will result if we should install, in lieu of the armored cable and conduit, ordinary rubber covered conductors run without additional protection through holes in timbers and stapled directly to the surface of the timbers. This should represent about the lowest limit for any wiring method which might be proposed by any group within the industry, and the economy gained by the use of such wiring method should represent about the maximum which might be expected through the elimination of "burdensome code rules."

A little calculation will show that the cost of labor and material for installing the lighting and appliance circuits when using unprotected rubber covered conductors installed as above in lieu of armored cable will amount to approximately $21.00, or a saving of $11.00. By discarding the steel tube to range outlet a further saving of $5.00 will be effected, making a total saving of about $16.00, or 12% of the total wiring cost.

Can it be possible that this item of $16.00, which represents only 12% of the total wiring cost and which spells the difference between reasonably safe

wiring and dangerous wiring, is burdening the sale, not only of kilowatt hours but of wiring installations, utilization devices and appliances to the ultimate disadvantage of everyone? Is it not more probable that just the reverse of this statement is true and that kilowatt hour consumption and appliance sales will be benefited through the installation of dependable wiring which makes for trouble-free service and a satisfied customer?

Why not look upon this $16.00 item as a premium for insuring the safe and dependable delivery of electric service to the $500 to $800 worth of fixtures and appliances which may be served through the wiring installation. This premium must be paid only once.

While on this subject of wiring costs we should take note of the relation between the cost of wiring and the total cost of electric service to the consumer over a period of time. In making this comparison I shall base my findings on statistical data furnished by one of our Portland utilities which shows, for the dwelling under discussion, an average annual current consumption of 2236 kilowatt hours and an average annual revenue of $58.98, or 2.64 cents per kilowatt hour.

At this rate of current consumption the consumer will, over a ten-year period, pay $589.80 for his electric energy. This makes his initial outlay of $130.00 for wiring represent about 22% of the amount paid for energy.

Carrying the comparison a little further we find that the saving of $16.00, resulting from the use of substandard and admittedly dangerous wiring, represents only 2.7% of the energy cost over a ten-year period and that a difference of only one-fourteenth of one cent in the rate which the consumer pays per kilowatt hour will more than nullify any questionable economy which might be obtained through the installation of admittedly dangerous wiring.

In view of these facts we are forced to conclude that the rate charged for energy and the amount of effort expended by industry to stimulate an active demand on the part of the public for electric service are the real factors which determine the extent to which this service will be used by the public, and conversely that it is not the price of wiring that is the retarding influence so much as the lack of selling. And, as a parting suggestion, I believe that industry should forget its differences of opinion about the National Electrical Code and get solidly behind some program for adequate wiring. Then, and not until then, will we have adequate wiring in the measure which we desire.

Fire Photography.

By A. L. Armstrong,
(Member N.F.P.A.)

Many cameras go to fires, but few come back with pictures of value. A top-notch fire photograph is one of the rarest of rare articles. Yet, although fire photography is one of the most exacting fields for the camera, it is not beyond mastery by any amateur who is willing to select his tools properly and learn to use them with judgment.

The Camera.

Good fire photography begins with the selection of a suitable camera and accessories. The camera need not be an expensive one, but it must fulfill several requirements, as follows:

LENS: The lens should be a sharp-cutting anastigmat, so that negatives can be enlarged for study of detail. It should have ample speed (rating of f.4.5 or better), so that it can be of service any hour of the day and under all weather conditions.

SHUTTER: The shutter should have a full range of speeds, preferably from one second to 1/250 or faster. The slow speeds are useful when light conditions demand extremely brief "time" exposures; the high speeds are valuable when rapid movement must be "frozen" for the picture to have record value.

HANDLING: The camera must be constructed for quick, convenient adjustment. Lens and shutter scale markings should be clearly visible and the instrument easy to hold. It should also be reasonably compact, to facilitate transport.

FOCUSING: The camera should have as full a focusing range as possible, to permit both general views and close-ups. Most focusing cameras have a range of about 3½ feet to infinity, which will take care of average needs. Front lenses or portrait attachments of the "slip-on" type permit still closer work. For extreme close-ups, however, a camera with double-extension bellows and ground-glass focusing is necessary: such cameras are less convenient to handle than other types, but have value as the second camera in a two-camera kit.

FILM CONTENT: The number of pictures a camera will take in one loading varies and is largely a matter of the individual photographer's preference. Smaller cameras using roll film take from eight to thirty-six pictures on a roll, depending on the camera design. Film-pack cameras load with a standard pack of twelve films. Pack film is useful in that a film-pack camera can be reloaded swiftly.

NEGATIVE SIZE: This again is largely a matter of choice. Suitable sizes range from 1 x 1½ inches up to 2¼ x 3¼ inches. If the photographer is limited to one camera, the 1⅝ x 2½ "vest pocket" size, or the 2¼ x 3¼ size is preferable. If he plans a two-camera kit, he can use a rapid 1 x 1½ minia-

A good example of what can be done under dull light. Ample exposure, and judicious use of light from the fire itself, produced a negative with detail all over — despite the fact that it was deep twilight when the picture was made. The picture is good in that it demonstrates clearly the condition of the structure in which the blaze originated, and the circumstances under which it was fought. It also has some pictorial quality, which is good provided it does not involve sacrifice of important demonstration points.

ture for general work and a film-pack camera with negatives as large as 3¼ x 4¼ inches or 9 x 12 cm. for close-ups in which texture and extreme detail must show.

Some photographers will question the idea of a medium-small negative camera for general work. It is recommended for several reasons. First, with a small camera there is a definite gain in "depth of field" or "depth of focus,"

The advantage of an elevated viewpoint is exemplified in this picture. Few fire photographers will have the use of an airplane for their picture work — but they can always seek a point of vantage. High viewpoints show the scene spread out like a map. Note how clearly the disposition of the fireboats and their operations are shown and how the area of the fire is clearly mapped.

which is of material value in hurried guess-focusing. Second, a small camera can be equipped with a more rapid lens without adding undue bulk and weight. Third, it is easier to carry and hold steady. Fourth, the vest-pocket negative is large enough to permit reasonable enlargements without excessive loss of texture and detail from film grain. And, fifth, the cost is less for a rapid-lensed small camera than for larger cameras with equivalent optical equipment.

Accessories.

We have dealt at length with choice of a camera because it is basic. There is little point in trying to do dependable fire photography, day in and day out, with inadequate equipment. Certain accessories are nearly as important and a full day-and-night kit should include:

One-Camera Kit.

A camera using roll film, or film pack, taking 1⅝ x 2¼ or 2¼ x 3¼ pictures, with f.3.5 lens or f.4.5, and shutter speeds to 1/250 second or more.

Two-Camera Kit.

A 1 x 1½ miniature camera with f.3.5 or speedier lens, and shutter speeds to 1/500 second, and a 2¼ x 3¼ (or larger) film pack camera with double-extension bellows and f.4.5 lens.

Accessories for Either Kit.

A compact folding tripod, selected for sturdiness, with strong universal head to permit tilting camera up or down.

A range finder to aid in focusing.

A dependable exposure meter.

A good steel tape measure, to be used in determining distances for close-ups where ground-glass focusing is not possible.

A portrait attachment or set of supplementary lenses to facilitate close-up work with the small cameras.

A lens hood (sun shade), which should be in place whenever a picture is snapped, whether it appears necessary or not.

A small pocket flashlight, to use in setting lens and shutter and focusing in night work or dark places.

Photoflash bulbs and holder or synchronizer. If a synchronizer is used, an extension cord should be provided so that the bulb can be placed in various positions in relation to the camera and subject.

Film.

Where only one camera is to be used, there is but one film that the fire photographer need consider. That is speed film of the supersensitive panchromatic type.

This film has several advantages in fire work over the usual amateur types. The extra speed is a major virtue, permitting briefer exposures and more assurance of usable negatives. Speed differences are more marked toward the end of the day and at night by artificial light, since the panchromatic film is sensitive to the excess of yellow, orange and red light that pre-

vails at these hours. Another valuable trait of the super-panchromatic films is their soft gradation, which tends to keep highlights from "chalking up" even with gross overexposure and full development.

If two cameras are to be used, the smaller, speedier camera should be loaded with supersensitive film and used on pictures where action must be stopped, or on general views when light is weak. The larger, slower camera should be kept loaded with a medium-speed film of the fine-grained panchromatic type and used on general views where light is ample and on all extreme close-ups where detail and texture are the chief considerations.

Training.

It should hardly be necessary to insist that a photographer learn his camera thoroughly and train himself in rapid, facile operation of it. Yet most would-be photographers neglect this and wonder why their pictures turn out so poorly.

Nothing but constant practice will allow a photographer to obtain the most from his instrument. It is not necessary that he work only on fires; indeed, in much of his training it is not even necessary that his camera be loaded. It is just as easy to practice focusing, setting of lens and shutter, gauging of distance, rapid winding of film, and the like, with an empty camera — and it is only when all these necessary motions are developed into semi-automatic reflexes that the cameraman is fitted to work at full efficiency.

In addition to routine camera operation, the photographer should study two other things — exposure, and rapid determination of a subject. His exposure guesses can be checked easily with an inexpensive exposure meter, or better still, with a few rolls of film. Experiments with distance and viewpoint on buildings of various sizes will give him an index to his camera's scope, so that when he first approaches a fire he can readily decide from what distance and what angle his first general views should be snapped. Both exposure calculation and subject judgment should become second nature, for a fire will not wait while the photographer makes up his mind.

Procedure.

In covering a fire, the photographer should seek to make a complete pictorial record. The pictures he takes will depend to some extent on their purpose — that is, whether they are to be used in insurance adjustment, fire prevention study, departmental training, or other fields. But the rule remains the same: the fire should be completely covered. Film negative material is cheap and a picture not snapped is a picture lost.

Fires will vary infinitely, but general procedure can be much the same for all. First, there must be inclusive views, showing as much of the scope of the fire as possible. Neighboring structures that may be involved should be snapped. Special views can be taken to show how the fire was fought.

An excellent picture for several reasons, illustrating weaknesses of an open fire escape, character of the fire, need of ventilation, and the way in which the elevated structure interferes with the fire fighting. It is a night picture, taken with flash powder, which has a tendency to "burn out" detail in any objects close to the camera. Note white foreground here.

There should be a record, as far as possible, from the general to the particular — down to extreme close-ups of the fire sources, when these can be determined.

Weather conditions and smoke are complicating factors well beyond the photographer's control. Rain is an inconvenience and the lens surface must be

protected from stray droplets: the lens hood is a help here. Falling snow is troublesome, in that flakes show as streaks when slow shutter speeds (1/10 second or more) are used; however, snow covering the ground can be a help, in that it reflects light on the building and improves shadow detail.

The Smoke Problem.

Smoke is an ever-present problem, particularly when atmospheric conditions make it hover low. A yellow filter on the camera will help cut through a very light smoke haze, but a dense pall is impenetrable. Flash powder shots taken in hazy smoke are generally failures, as the bluish haze catches the light close to the camera and blots out the farther parts of the scene. A lens hood is particularly imperative in smoke or haze, for under these circumstances light is picked up and scattered into the lens from every angle.

Correctly timed exposure under bad weather conditions is not so difficult a problem as most photographers would make it. Only three factors are involved — the strength of the available light, the lens opening, and the shutter speed. Over the last two of these the photographer has full control and by combining various openings and shutter speeds he can give his negative exactly the right amount of light regardless of weather or lighting conditions.

As a rule, the fire photographer should give as full an exposure as conditions permit. It is sound practice to use the exposure meter regularly, and when that is impossible, to give a bit more exposure than the scene apparently needs. Full exposure is the only practical way to obtain clear-cut shadow detail in fire pictures.

Many special conditions require still more liberal exposure.

When it is raining, give more exposure. When pictures are snapped extremely late or early — that is, near sunrise or twilight — give more exposure. When the subject is especially dark in color, give more exposure. When the subject is all in deep shadow, give more exposure.

Use Liberal Exposure.

These repeated admonitions to liberal exposure may puzzle camera users who are accustomed to giving much less, but full exposures are recommended for two reasons. First, the fire photographer must get a picture; he cannot risk underexposure. Second, his pictures must show full detail all over if they are to be a complete record; he cannot risk blank shadows. And, since he cannot pose his pictures or arrange special reflectors to illuminate shadows, his only course is to let plenty of light reach the film, which has enough softness and latitude to preserve highlight detail even when the highlight parts of the picture are grossly overexposed.

Especially should the photographer liberalize his exposure when lighting is harsh — as in noon sunlight — and when it is extremely weak, as toward twilight. When he encounters an extremely "flat" subject, with little contrast,

This is a good fire picture, not only because of pictorial quality, but also because it has point. It demonstrates perfectly the rapid ignition of a wooden shingle roof, and makes an excellent picture for use in fire prevention work, educational and safety campaigns, and similar fields. It was taken by John T. Brawner, Jr., an amateur. If this picture could have been taken from a higher elevation, the distortion of the vertical lines would have been avoided.

he can adopt a special method if he has a film pack camera. He should take three pictures, one with a normal exposure, one with half that, and one with exposure of one-fourth to one-sixth of normal. The two short exposures should then be singled out from the other films and given a long development to build up contrast, while the normally exposed film is given normal development. Prints can then be made from all three negatives and the one selected that best demonstrates the subject.

The practice of taking three exposures can be utilized for normal subjects when the photographer is in doubt about the strength of his light. In this case, exposures should be lengthened — one shot at the estimated normal exposure, one at about three times normal, and one at six times normal, or even more. This is sound picture insurance.

Good cameras have a full range of lens openings and shutter speeds. This is to provide for "action" pictures and extreme close-ups, in addition to normal views. High shutter speeds must be used when there is rapid move-

ment in the picture — a falling wall, or men running. Conversely, a small lens opening should be used in close-up work on still subjects, because the smaller the opening, the more "depth of focus" the lens has. The sharp-focus band decreases rapidly in width as the camera is brought closer to an object.

In shooting action subjects, the best rule is to have the lens "wide open" and use as high a shutter speed as the light permits. A little blur helps the pictorial effect of some action pictures, but it injures a record picture. In taking pictures of this sort in bad light, the photographer must decide which is more important — sharpness or shadow detail. If sharpness is imperative, he can often afford to increase his shutter speed, thereby reducing exposure and sacrificing shadow detail, but getting a picture quite without blur.

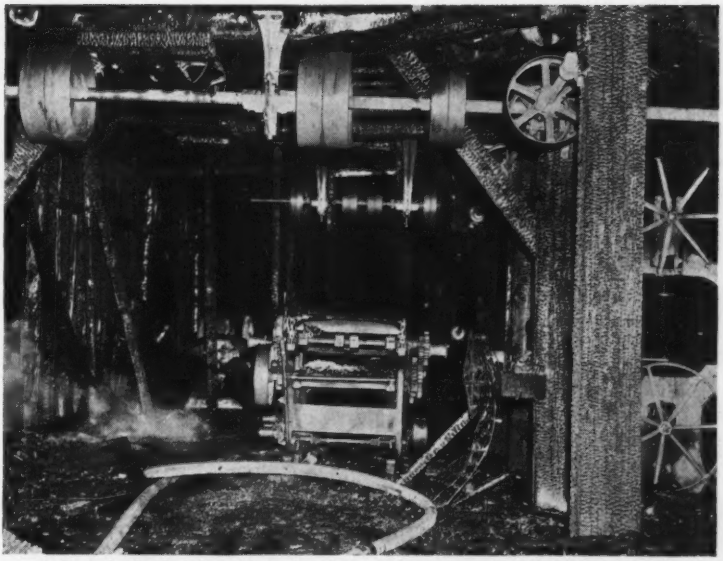
Extremely dark subjects, as charred wood and smoke-blackened interiors, present a special problem with which the photographer must cope. Dull black reflects so little light that exposure must be increased tremendously on an all-black subject. Where the blackening is splotchy, however, normal exposures are best, in that they retain the contrast of the original. Charred wood with a rough surface can be photographed successfully by using strong side-lights and increased exposure, as the surface irregularities cast shadows which give the subject texture and relief.

Night Fires.

Night photography of fires involves so many variables that it is impossible to offer a set of rules. The extent and temperature of the fire, the amount of general illumination from street lighting, reflecting surfaces like wet streets and snow, floodlight and spotlight equipment used by the fire department, all play a part.

If the photographer requires detail in a general fire scene at night, flash bulbs, flash powder or magnesium flares such as are used by newsreel photographers may assist him. He should under no circumstances use flash powder when there are flying sparks, — loss of his eyes, face or hands may result. Both flares and flash powder involve additional fire hazard and should be used only in emergencies.

When the photographer works with such general light as is available, his best recourse is to set up the camera on a tripod and give a series of "time" exposures with lens wide open — for example, with an f.3.5 lens exposures of 1, 3, 5, 10, and 30 to 60 seconds. If the fire is hot, brilliant and plentiful and street light ample, still briefer exposures can be given with occasional success. When a building is outlined in fire, or a wall silhouetted against fire, it is possible to record the flames alone with snapshot exposures as rapid as 1/20 at f.2, or 1/10 to ½ at f.3.5. Time exposures of 3 to 5 seconds at f.8 give about the same result. Slow hand snapshots can be made with small cameras that have eye-level view-finders if the photographer braces his head firmly against some rigid support, as a lamp-post or wall, and braces his elbows against his



A flash-bulb shot in which charring of wood is well illustrated, despite the blackness and intrinsic lack of contrast in the subject. This interior received a flat front lighting from a flash-synchronizer mounted on the camera, but sometimes sidelighting is necessary to give contrast and relief and make charring show up properly.

chest. It is still better, if he has no tripod, to rest the camera on some solid support, like a fence or automobile fender, while the brief exposure is made.

Photoflash Pictures.

Photoflash work on ruins is confined to fairly small scenes and close-up work. In making such pictures, the photographer should not rigidly follow the exposure data supplied with the bulbs, unless his subject is of average lightness. If he is dealing with a charred, blackened subject in which there are no light-colored areas of importance, his flash bulb must be held much closer to the subject, or a much larger stop opening used. The bulb should be placed to give a side-lighting rather than flat front light, as this helps the contrast of the subject. Where blackened subjects are small, reasonably small lens openings can be used because it is possible to bring the flash bulbs close. Where a subject of fair size must be shown, the bulbs must be moved back — but since the camera is also moved back the lens can be opened wider and a satisfactory depth of focus still maintained.

In arranging his lighting, the photographer should keep one rule in mind. That is, that anything which is to show up in the print must receive light when the picture is snapped. This is so obvious that it seems almost silly to

point it out — but it is surprising how many photographers ignore the lighting of details that must show if the picture is to have value.

One rule applies to the arrangement of any fire picture. The picture must have point — it must demonstrate something. The photographer must decide what he wants to illustrate, and then choose a viewpoint and distance that make the illustration most effective. Sometimes, to show a subject fully, he must take several pictures from various angles. This is not a waste of time and film: it is imperative, for a half-complete record is almost as bad as no record at all.

Other useful suggestions are: Keep cool. Hold the camera steady and to take care of possible unsteadiness, use as rapid a shutter speed as light allows. Focus carefully, for an out-of-focus fire picture is worthless. And, do not waste film in snapping pictures from too great a distance — the details *must* show.

We will not detail methods of picturing spectacular fires, because this is pictorial work — based more on knowledge of picture composition than technique. The fire photographer who wishes to supplement his record pictures with others of dramatic and pictorial interest should study picture composition and arrangement, both in textbooks on the subject and in published photographs or print collections. It is a worthwhile field and any fire record is improved by the presence of pictures with intrinsic pictorial value.

Processing.

Earlier in this article, we have recommended exposures as liberal as possible to take care of shadow detail. This calls for a somewhat special type of development. Films given liberal exposure should be developed in a soft-working developer — such as the D-76 Borax formula — to prevent blocking or "chalking-up" of highlight detail.

The D-76 formula recommended has three virtues: it pulls up more shadow detail than ordinary MQ formulas, preserves highlight gradation and gives fine grain, which is valuable if small negatives are to be enlarged. Moreover, by varying the relative proportions of metol and hydroquinone, it can be made to give more or less contrast, according to individual requirements.

If the photographer develops his own films, he can, of course, choose his developer. If his films are developed by a finisher, he should make special arrangements, explaining the exposure his fire films will receive and the need of soft development.

The final size of the finished prints is a matter of the maker's choice. Important pictures can be enlarged, less important ones kept in contact size. In enlarging, the fire photographer should remember that negatives can be masked so that the finished print is made only from the part of the picture that is of importance, with surplus details at top, bottom and sides eliminated.

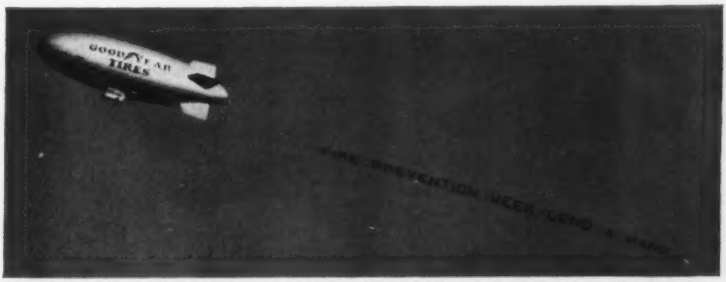
Los Angeles Fire Dept. Public Relations.

By Captain Orville J. Emory.

In 1926 Chief Ralph J. Scott of the Los Angeles Fire Department established a Public Relations Bureau, which was the first bureau of its kind in any of the branches of the municipal government in Los Angeles. Included among its many duties is the fostering and promotion of educational campaigns, and the promotion of coöperation and good will between the fire department and the public. The work performed includes the task of reaching and interesting the many individuals who are barely conscious of the existence, let alone the purpose and responsibilities of the fire department The members of the bureau are called upon to fill engagements at clubs, lodges, schools and other civic organizations. Most of this work must be done after regular business hours. The features stressed at these outside contacts include talks on safety, motion pictures, and practical demonstrations of fire and rescue equipment.

The place of the Public Relations Bureau in the department is now considered as important as the Fire Prevention Bureau, Arson Bureau, Fire College, Rescue Companies, and other specialized fields of work that are necessary units of a municipal fire department.

Several years ago the University of Southern California, by popular request, added to its curriculum a course in public relations. To their surprise, they discovered that there were no textbooks on this subject. The first class was made up of twenty men and women, most of whom were public relations employees from private industry. Five public relations members of the Los Angeles Fire Department enrolled in the first class. From this humble beginning, which was a series of round table discussions on the subject as it was



Dramatic publicity was supplied by "blimps" dragging fire prevention slogans. This and the following pictures show features of the Los Angeles Fire Prevention Week Campaign of 1937.

One hundred and twenty-five large billboards were dressed like this one for thirty days.

practiced by the organizations represented, the university had, last summer, during its short course in its School of Government, more than five hundred in attendance at each of its special assemblies on public relations.

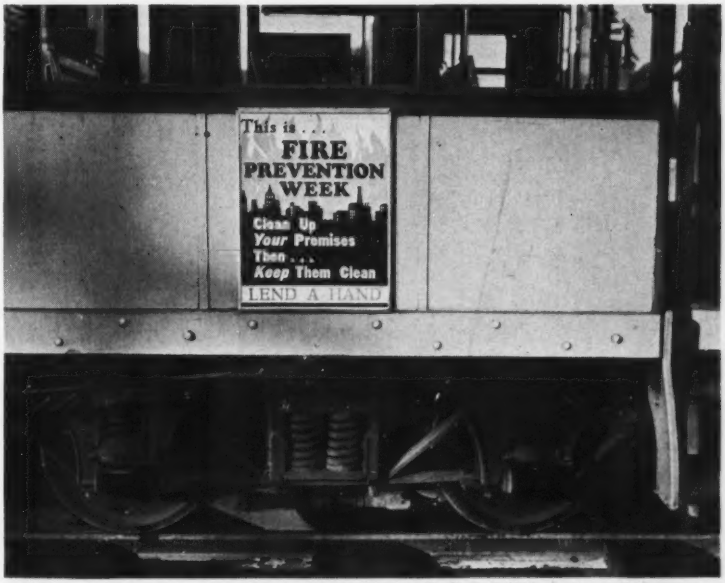
Public relations work in the fire department is not necessarily confined to two or three men. Every member from the highest chief officer down to the newest recruit should consider himself a public relations man. Every contact he makes with the public, whether he be on or off duty, reflects the type of service which may be expected from his department.

Many government employees lose sight of the fact that the department in which they work does not belong to them, but to John Public. The plainest individual may be the biggest taxpayer and most influential citizen in the community. A little personal attention or a courteous reception may win a lifelong friend for the department. Willingness to coöperate with the public and be of service has paid handsome dividends to our own firemen in the form of working conditions, salaries, pension rights, and in many other less tangible ways.

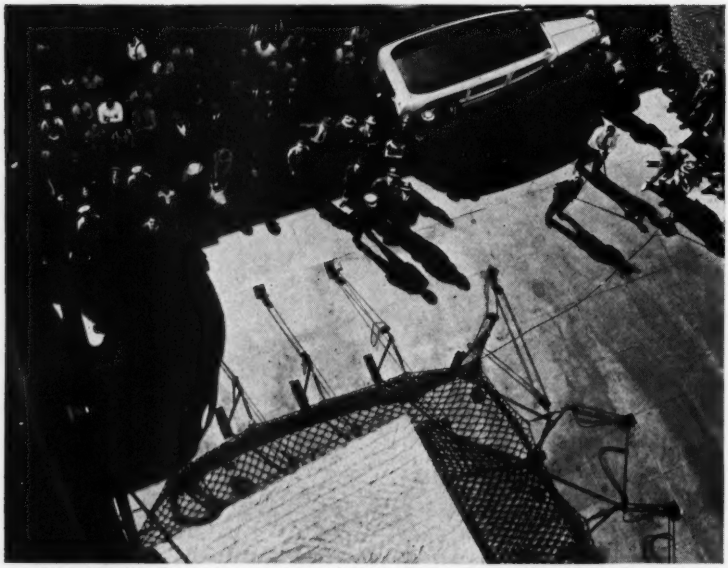
Men who are detailed to a bureau such as the Public Relations Bureau should have special qualifications to properly represent their department in fulfilling the many assignments designated to them. They should be neat, courteous, tactful, loyal, modest, alert and diplomatic. They should be familiar with all regulations and policies of their department, and in addition should have a working knowledge of every branch of its service. They should be capable public speakers, and willing to work at any and all hours.

Fire Prevention Week Oct 3-9
This Is FIRE PREVENTION WEEK
SPONSORED BY LOS ANGELES CHAMBER OF COMMERCE
TRUCK. Courtesy VAN VELSIR SYSTEM. TRUCKING

Through the streets rumbled great trucks, carrying various displays like this.



Street cars carried posters inside and out. Railroad tickets bore fire prevention slogans.



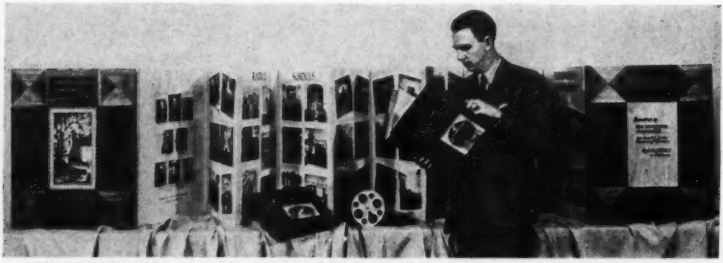
Los Angeles firemen opened up their training school for public display and went through the more dramatic drills. The entire program was broadcast over a radio network, and photographed for the local theatres. Note the Announcers and Cameraman on the right of the picture.

Children, urged on by their school teachers and the firemen, produced interesting and elaborate fire prevention displays.

Local merchants coöperated in the program by filling their windows with fire prevention publicity.

Wrecked automobiles placed at parking lots in strategic positions throughout the city illustrated graphically what might happen if motorists ignored the siren and bell. A uniformed fireman stood by to answer questions.

The work done by the Bureau of Public Relations in the Los Angeles Fire Department covers quite a diversified field. Talks on fire prevention and public safety are given to student bodies in 375 public and 85 parochial schools; lectures to civics classes in high schools and colleges on fire department administration and the fire department as a vocation; demonstrations and motion pictures to science and first aid classes on portable fire extinguishers and first aid methods and equipment, organization and supervision of fire brigades, and drills in schools as well as in industrial plants; talks and motion pictures in churches, lodges, civic and service clubs, Parent Teachers groups, American Legion Posts, and other active organizations.



The Public Relations Bureau coöperated with the schools and other civic agencies of Los Angeles in keeping accurate records of all that was done. Captain Emory sees in this picture why Los Angeles shared highest Fire Prevention Week honors this year.

During the past seven years more than 2000 radio talks, interviews and dramas on fire prevention, fire service and personal experiences of members of the department have been presented over local radio stations. Many of the programs have been released over the Pacific Coast Network and a number of them have been on a national hook-up.

Articles are prepared for magazines, house organs, and daily and weekly newspapers. Work with Boy and Girl Scout troops and other youth organizations is a very important part of our program. One of the newest and most successful endeavors has been the preparation of material and technical advice on a series of educational motion pictures.

Fire Prevention Week Campaign.

During National Fire Prevention Week last fall, the Bureau worked with the Junior Chamber of Commerce in putting over a fine campaign. As Chairman of the Fire Prevention Committee of the Junior Chamber, it was possible for me to coördinate my duties as Director of Public Relations with those delegated to the head of the Fire Prevention Committee. Another position I accepted because of its relation to the work of our bureau, was that of a director of the Boy Scouts of America and the National Boys' Week movement. The job of radio chairman of Boys' Week in Los Angeles fell to my lot for the fourth consecutive year, and we were able last year to present over 400 boys who gave talks and furnished the music in 23 broadcasts. In this way, the attention of the youth of Los Angeles was focused on civic duties and particularly on fire prevention.

As the bureau increases in personnel, it is possible to accomplish more and more each year, and we hope that additional men may be available in the near future to assist in our public relations work.

EDITOR'S NOTE: We know of no other fire department that maintains a public relations bureau. Captain Emory's modest account is only an indication of the value of this service to the fire department and to the citizens of Los Angeles.

De la Howe School Fire, Abbeville, S. C.

By Chief C. P. Townsend,
Abbeville Fire Department.

Fire completely destroyed the main dormitory of the De la Howe State School, eighteen miles from Abbeville, S. C., on November 7, 1937, because no water was available for fire fighting. The fire started in a basement workshop about 7:00 P.M. No lives were lost, but had the fire occurred after midnight there is no question in my mind but that well over one hundred of the 196 children housed in the building would have lost their lives.

Construction and Equipment of the Building.

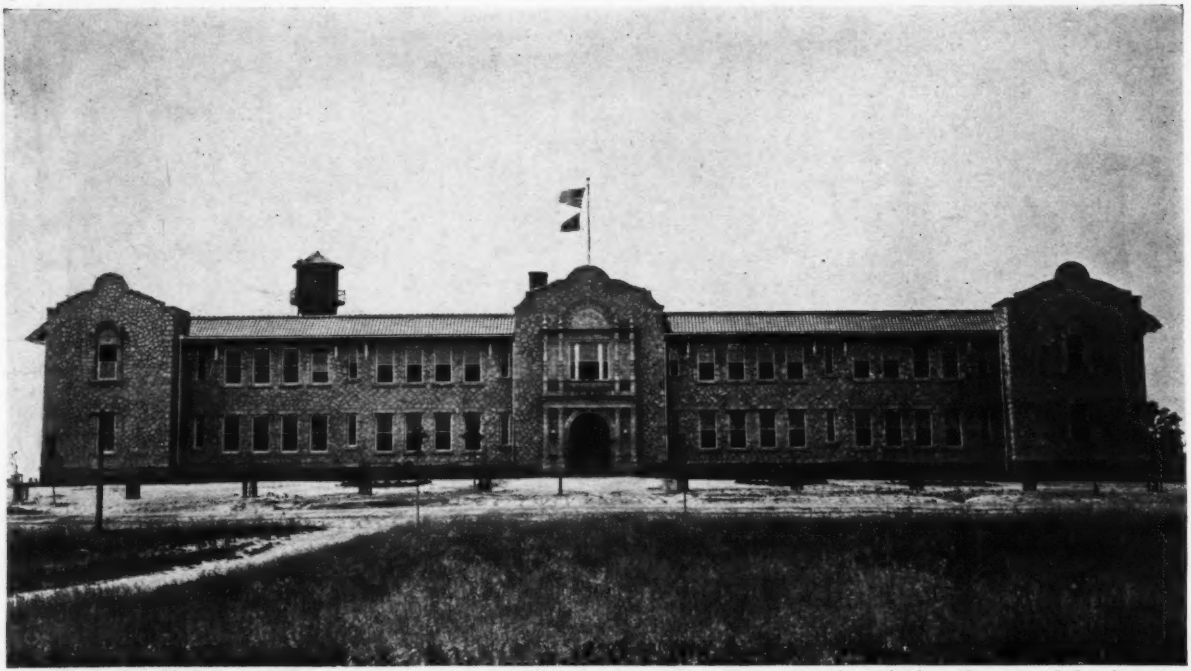
The building was two stories high, of stone veneer with wooden joist construction, metal ceilings and plaster walls. It was originally rectangular in shape, but later additions of the same construction gave it a letter "E" shape when viewed from above. In the middle section were the kitchen and dining room on the first floor, and auditorium on the second floor. The main part of the building, together with the two added ends, was used as offices and classrooms on the first floor and as a dormitory and sleeping quarters on the second floor. The De la Howe School dates back to 1796, and at the time of the fire was an accredited high school with grades from the first to the eleventh.

The only fire fighting equipment provided in the building was two 1½-inch standpipes in the main hall with four racks, each containing 50 feet of 1½-inch linen hose. These were connected to a very meager water supply, and there were no outside fire hydrants. A complete sprinkler system with ample water supply and outside hydrants was under construction. Only about half of the work was completed at the time of the fire and nothing was connected and available for use.

Story of the Fire.

We received the alarm a few minutes after 7:00 P.M. and made the run of eighteen miles in fifteen minutes, with a 500-gallon pumper and 900 feet of hose. Upon arrival we found the fire in the basement of the right added section just burning through the floor. Had a water supply of 10,000 or 15,000 gallons been available within 500 feet we could have brought the fire under control with our equipment. We attached our leader line hose to one of the building hall lines and got a small stream of 10 to 15 gallons per minute on the blaze, but could accomplish nothing with this small amount of water. All we could do was to stand by and watch the building be consumed.

In a few minutes the fire had burned a sufficient area in the floor so that all the hot gases and products of combustion could emerge on the first floor. There was no fire door (I think no door at all) between the added section and



The tank behind the building was empty — not yet filled or connected to the automatic sprinklers that were being installed. When fire started on November 7, 1937, the result was the complete destruction of this school near Abbeville, S. C., with a loss of $225,000 to the state fund. The fire department arrived in fifteen minutes, after a run of 18 miles, but could do nothing without water.

the main section, and these gases, fanned by a breeze, entered the hallway of the main part of the building and mushroomed on the second floor. In about twelve minutes these hot gases ignited and soon the whole top floor of the main building was involved. They ignited first at the hottest spot, which was at the head of the stairway. When these burning gases found outlets through open windows they seemed to draw out a large part of the combustible gases which had mushroomed over the building. The fire then spread in a progressive manner from the actual heat of the part of the building which was burning, taking about one hour to fully involve the main section and then over one-half hour to involve the other two added sections in the rear.

The fire started in the basement workshop, in which it was reported that dry gum lumber was stored. This would indicate that it was a carpenter shop with shavings and perhaps paints, varnishes, rags, and other combustible materials scattered around. It is my opinion that the fire started from spontaneous ignition. The loss of about $225,000 was largely covered by insurance carried with the Sinking Fund Commission under a plan devised by the General Assembly several years ago to carry insurance on all state owned buildings.

At the sound of the school fire alarm all the children had marched out of the building in an orderly manner and none was injured. There were no outside fire escapes, and had the fire occurred when the children were asleep on the second floor, the hot gases mushrooming there would probably have trapped over a hundred children. The stairways, with the hot gases sweeping up them, would have been death traps.

Recommendations.

Had the installation of the sprinkler system been completed and in operation it almost certainly would have extinguished this fire while it was yet small. In addition to an automatic sprinkler system to prevent serious fires in buildings such as this, the writer recommends:

1. An ample water supply with some 2½-inch hose, and hydrants outside the building.
2. The installation of properly approved fire doors and fire walls to prevent the spread of fire from one part of the building to other parts.
3. Some employees trained as a fire fighting unit.
4. Frequent inspections to eliminate the accumulation of rubbish, particularly greasy rags and shavings, and to limit the amounts of flammable liquids (in proper containers) such as paints and gasoline.
5. Some responsible agency to see that fire fighting equipment is kept in proper condition and that inspections are made and regulations enforced; this agency not to be connected with the owners or operators of the building, and to have disciplinary powers.

For the safety of occupants of such buildings the writer recommends:

1. The construction of properly approved fire escapes.
2. Besides a night watchman, some type of automatic fire alarm system to detect fires before they gain headway.
3. Frequent fire drills, especially at night, to accustom the occupants to the use of fire escapes.
4. Prohibition of large numbers of people from sleeping or congregating in hazardous buildings, where fire could cut off all means of escape.

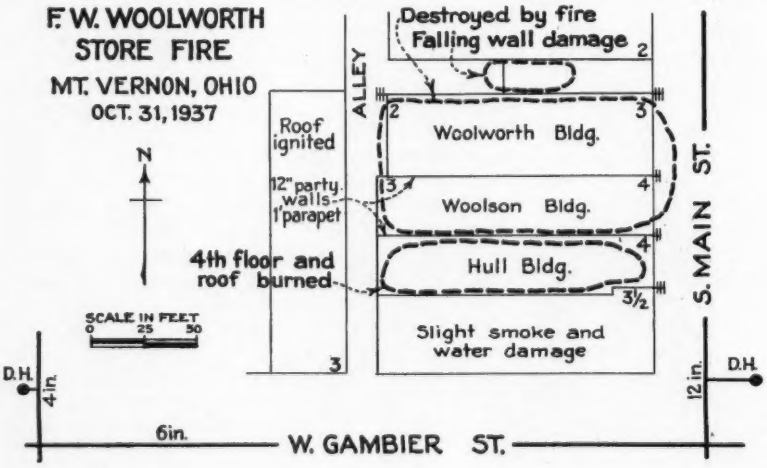
Two F. W. Woolworth Store Fires in Ohio.

Reports by Ohio Inspection Bureau,
(Member N.F.P.A.)

Within seventeen days of each other two fires starting in basements of F. W. Woolworth Company stores in two Ohio cities completely destroyed the buildings of origin and adjoining buildings, with a combined fire loss of over one million dollars. Quantities of Christmas goods, largely of a flimsy nature, were stored in the basements. Both fires were of undetermined origin and are typical examples of the difficulties encountered by firemen in combating basement fires. Both fires show how basement fires in combustible stocks can burn unnoticed for sufficient time to be beyond control when they are finally discovered and the fire department is called. Neither of the buildings had properly protected floor openings or were equipped with automatic sprinkler systems. Under these conditions, nothing less than total losses could reasonably be expected. The first fire occurred in Mt. Vernon and the second in Columbus.

Mt. Vernon, Ohio, October 31, 1937.

The Woolworth Building was of ordinary brick, wood-joisted construction, three stories high, with composition roof, and with open stairways through all floors. The store occupied the basement and first and third floors. An amusement hall and an electric appliance store occupied the second floor. At 9:00 P.M. on Sunday a patrolman saw smoke coming from the basement. The fire department responded immediately. After some difficulty and delay,



entrance was gained to the first floor through a steel-barred door in the rear. At this time there was no evidence of fire on the first floor, but much heat and acrid smoke were coming from the basement. The fire department was not equipped with modern gas masks, but the chief states that had masks been available they could not have been used because of the intense heat. The department confined its efforts for some time to directing streams into the basement through outside openings. Finding this ineffective, holes were cut through the first floor into the basement, but shelving and other obstructions still prevented water from reaching the seat of the fire. Gaining intensity by feeding on flammable Christmas stocks, the fire finally burst out of the basement and rapidly involved the entire building.

Fire soon spread to the adjoining Woolson Building by the way of the roof; the parapet on the party wall was only one foot high. The Woolson Building was four stories high, of ordinary brick wood-joisted construction, with open elevator and stairways. Both side walls were party walls. A shoe store occupied the basement and first floor, and the occupancy of the upper floors was store fixture and furniture storage. From this building the fire worked over another low parapet to the Hull Building, which was of similar construction to the Woolson Building, and was occupied by an office supply, book and wall paper store. In addition to the Woolworth and Woolson buildings being destroyed, the roof and top floor (fourth) of the Hull Building were destroyed and all stock on the lower floors was badly damaged or completely ruined by smoke and water. There was slight damage to the fourth building in line, and a roof across the alley was ignited but quickly extinguished.

When it was seen that the local fire department was losing ground, the Newark Fire Department was asked for help and responded with a pumper and four men. This department set up a 2-inch turret pipe in front of the Hull Building, which apparently was instrumental in preventing the total loss of the building.

Properly constructed fire walls with standard parapets should have prevented the fire from going outside the building in which it originated, and properly protected floor openings would have retarded the spread of the fire in the individual buildings. Automatic sprinklers would certainly have been effective in preventing the spread and in extinguishing the fire. The results of this fire clearly demonstrate that the local fire department is insufficiently manned and inadequately equipped to cope with serious fires. The total loss was estimated at $300,000.

Columbus, Ohio, November 16, 1937.

The Woolworth store occupied the basement, first floor, and rear portions of the second and third floors of a 5-story ordinary brick wood-joisted building with unprotected floor openings. A dentist's office was on the second floor,

Capitol City News and Photo Service.

Only the outside walls of this 4-story building occupied by the F. and W. Grand Company store were left standing after the $750,000 fire in Columbus, Ohio, on November 16, 1937. The fire communicated from the 5-story building at the left occupied by the F. W. Woolworth Company store, which was completely destroyed.

and other floors at the front were vacant. Shortly before 10:30 P.M., while three employees were working on the first floor, a policeman noticed smoke coming from beneath the front door. The fire had gained considerable headway before being detected and firemen experienced the usual difficulty in combating this basement blaze, although they were able to enter the basement from the rear for a limited time. Numerous hose lines had been laid and were available for use as the fire worked through the upper floors of the building. Firemen used several hose lines from roofs of buildings on each side and from the floors and roofs of the buildings across the street in the rear. Two turret nozzles with four hose lines feeding each were set up and used in front of the building.

Twelve feet from one side of the burning building was a 5-story building occupied by the Kresge store, but fire was kept out of this building in spite of the many unprotected openings in the exposed wall. Stock in the basement was slightly damaged by water. It was felt that fire would not spread to the building on the other side since the exposed wall was blank, 12 inches thick, and parapeted. However, about 1:45 A.M. fire entered the third floor of this building. This building was four stories high of similar construction to the building on fire, and the basement and first floor were occupied by the F. and W. Grand Company. A jewelry store occupied the second floor and the American Legion occupied the third floor. Among other tenants was a photograph

studio on the fourth floor. Floor joists entered the exposed wall for a distance of four inches, and the most plausible explanation is that sufficient heat penetrated this wall to ignite wooden bar fixtures installed along the wall on the third floor. Fire spread rapidly across this floor and worked upwards and downwards, involving the entire structure. The exposed wall soon collapsed, nearly trapping five firemen.

The fire department had a total of 18 engine, one hose, and eight ladder companies at the fire. All firemen and policemen off duty were called by telephone and radio to report for duty. In addition, the surrounding departments of Grandview Heights, Upper Arlington, Worthington, Reynoldsburg, and Delaware sent men and equipment to protect other parts of the city.

Brick division walls in both buildings were ineffective, since they were supported on the first floor by unprotected or poorly protected iron columns. Both buildings and contents were almost completely destroyed, with an estimated loss of $750,000. This fire again shows the need for better building construction and for the installation of automatic sprinkler systems or automatic fire alarm systems.

Fatal Colorado Barn Fire.

Report by T. P. Treadwell (Member N.F.P.A.),
Chief, Fort Collins Fire Department.

Unknown to the fire department and other civic authorities of Fort Collins, Colorado, six persons, a man, two women, and three children, were living prior to November 19 in a frame barn lined with paper cartons. Besides three makeshift beds, the barn was equipped with a coal stove having a metal flue that passed without protection through the shingle roof. When, early on the morning of November 19, this stove was responsible for a fire in the barn, the six occupants were suffocoated and burned to death.

Story of the Fire.

At about 3:00 A.M. an employee of a railroad roundhouse was looking toward the old barn near by. He noticed that the chimney was beginning to emit a very dense gray smoke. Knowing fuels, he knew that someone had filled a stove with fine hard coal. He went about his business and thought nothing more of it.

At 4:30 an early morning newsboy rode his bicycle past the barn. He was the first to notice a fire. It had burned a hole in one corner of the roof. Hearing no sound, he assumed the building was no more than a barn, and headed his bicycle for the newspaper office four blocks distant. From there the alarm was given.

Meanwhile, a police officer in a cruising car also noticed the fire. He

stopped to investigate. Dense smoke was pouring from the structure. While he watched, an explosion occurred, and the whole interior of the building started burning furiously. He started for the fire station, but met the department already on the way.

At the building, the fire department swung into action quickly and subdued the blaze. Investigation showed that there had been six persons in the barn, all horribly burned and still in their beds. A dog under one of the beds showed no signs of burns, but had died of suffocation.

Cause of Deaths.

According to Chief Treadwell there was evidence to show that the persons had been overcome by coal gas, then burned. Neither of the early witnesses of the fire had heard any sounds whatever from the burning barn. The fine hard coal burning in an old and poorly designed stove could well have produced this fatal gas in abundance. The lungs of the dog were shown to have completely collapsed. Blood vessels in his nostrils had burst.

During Fire Prevention Week, this building had been inspected by the Fort Collins Fire Department as one of those not having a brick or other suitable flue. Chief Treadwell reports that it was then nothing more than a deserted barn. Imagine the shock to the fire department, who thought they were fighting a routine barn fire, when they found that six persons had been burned to death.

Coal gas, issuing from the stove in the lower right-hand corner of the picture, overcame the six persons who, unknown to civic authorities, were living in this frame barn. Soon afterwards, the same stove set fire to the paper lined interior and the fire burned them all beyond recognition.

Oil Storage Tank Fire Record.

Serious fires are of infrequent occurrence in modern oil storage properties, despite the inherent hazard of gasoline and other flammable liquids. The fire record shows that these hazards can be controlled through the various measures recommended by the N.F.P.A. Committee on Flammable Liquids, and detailed in the Suggested Ordinance on Flammable Liquids. These precautions are widely observed in modern oil storage plants maintained by the major oil companies, and a survey by the American Petroleum Institute for the year 1936, based on reports from a number of the larger oil companies, showed a loss of only $99,438 (not including oil stocks) in 10,259 oil storage properties (A. P. I. Quarterly, Oct., 1937).

The total loss on all oil storage properties for the year 1936, including the loss of stocks of oil and oil storage properties not covered by the reports of the American Petroleum Institute, is estimated at $3,520,000. This estimate, based on fire marshal reports from typical states, shows approximately 1600 bulk oil storage fires (including filling stations and refineries). The figures on which the estimate is based appear in the October, 1937, QUARTERLY, page 159.

Practically all of the serious oil fires reported to the N.F.P.A. are clearly due to neglect of one or more of the provisions of the Flammable Liquids Ordinance. Most of these fires occurred in connection with equipment not in accordance with modern standards, or were due to the carelessness of irresponsible or incompetent operators.

The files of the Department of Fire Record of the National Fire Protection Association contain reports on 176 fires, involving aboveground gasoline and oil storage tanks, which have occurred from 1918 to date. This fire record includes fires in tanks located on tank farms, in refineries, at bulk terminals or distributing stations, and in similar occupancies having large scale tank storage, which was a factor in the start or spread of fire. It does not include fires in oil burners, or other relatively small scale storage and use of oil, nor fires in filling station property, tank trucks, oil barges or tankers, tank cars, underground steel or concrete storage tanks, and oil storage reservoirs, unless aboveground tanks were also involved. While there are a few recorded fires, or explosions in underground tanks they are not included herein because they are in the nature of freak cases which are very much the exception.

The 176 fires are only a small fraction of the total number of fires occurring in storage tanks during the 20-year period. Authentic and complete reports on oil fires are difficult to obtain and many fires of minor importance are not reported. This fire record should, therefore, be considered only as a typical cross section of the more important oil storage tank fires.

Construction, Capacity, and Contents of Tanks.

All except five of the 574 tanks involved in this record of 176 fires were of steel construction as indicated in Table I. In most instances details of construction were not given, but apparently a large part of those in the "steel" classification were vertical steel tanks with wooden roofs, an obsolete type. Also, some of the "all steel" tanks were vertical tanks without gas-tight roofs. Few of the tanks had adequate vents to relieve excess pressure.

As indicated in Table II, nearly half of the tanks involved (where the capacities are known) were from 1000 to 25,000 gallons capacity, and one-fourth were in the largest size group — 1,000,000 to 3,360,000 gallons. The total estimated capacity of the 574 tanks was about 400,000,000 gallons, or about 10,000,000 barrels.

Table III shows the kind of oil stored in the tanks involved in the fires.

Table I. Construction of Tanks.

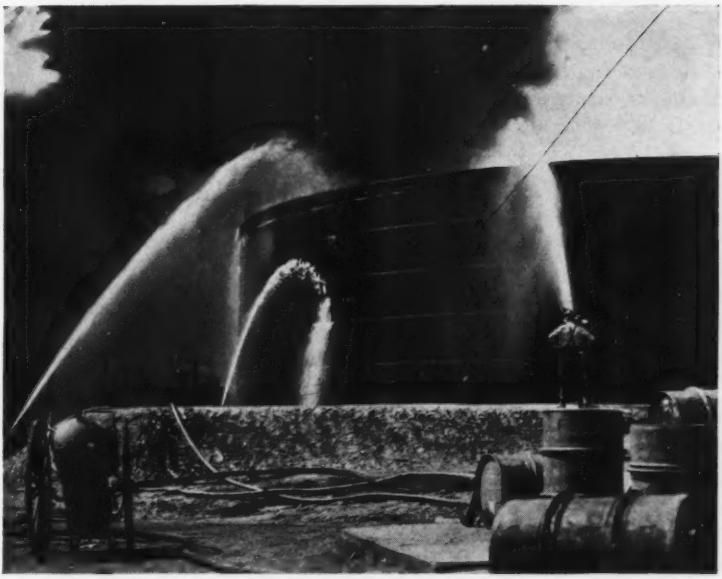
Construction	Number of Tanks	Per Cent
All Steel	164	29
Steel with wooden roof	59	10
Steel (no other specifications given)	346	60
Wood	5	1
Total	574	100

Table II. Capacity of Tanks.

Size in Gallons		Number of Tanks	Per Cent
1,000 or less		16	5
1,001 to 12,000		74	22
12,001 to 25,000		87	26
25,001 to 50,000		15	5
50,001 to 100,000		22	7
100,001 to 1,000,000		35	10
1,000,001 to 3,360,000		83	25
1,575,000 (37,500 barrels)	14		
2,310,000 (55,000 barrels)	48		
3,360,000 (80,000 barrels)	7		
Miscellaneous capacities	14		
Total (known sizes)		332	100
Capacities not given		242	
Total tanks involved		574	

Table III. Kind of Oil in Tanks Involved.

Oil in Storage	Number of Tanks	Per Cent
Gasoline	241	42
Crude oil	71	12
Kerosene	37	7
Fuel oil	14	2
Kind of oil not specified	211	37
Total	574	100



Baltimore, Md., July 19, 1920. Firemen cooling the 55,000 barrel tank of crude oil which was threatened by the conflagration that destroyed seven other large tanks and nineteen buildings.

Causes of Fires.

Table IV shows that 44 per cent of the tank fires where the causes are definitely known were caused by lightning. A study made by the American Petroleum Institute in 1925 of 304 oil tank fires occurring in the 10-year period from 1915 to 1925 showed that 55 per cent were due to lightning. No doubt the general practice of many oil companies of replacing old, wooden-top vertical tanks with modern gas-tight construction explains the decrease in the number of lightning fires in recent years. Of the 230 tanks ignited by lightning as reported in the A. P. I. study, 93 per cent were not gas-tight. Lightning igniting all-steel horizontal tanks and gas-tight vertical tanks is unusual, and when it does the records as a rule give evidence of unprotected vents or other non-standard conditions. Isolated oil tanks that are not of the gas-tight type of construction make excellent targets for lightning, and since protection of such tanks is often deficient, the resulting losses are likely to be large.

Static sparks and other sources of ignition during tank and tank truck filling operations are responsible for many fires involving storage tanks. While

the presence of flammable vapors perhaps cannot be entirely avoided, care on the part of employees will prevent the majority of such fires. Carelessness during repairing operations, exposure to open fires or fires in other property, and sparks from electrical equipment not suitable for use in the presence of flammable vapors are other common sources of ignition around oil tank property.

Table IV. Causes of Gasoline and Oil Storage Tank Fires.

	Number of Fires	Per Cent
Lightning	63	44
Tank truck filling operations	16	11
Static sparks	5	
Backfire or exhaust from gasoline engine	3	
Ignition from tank truck engine	2	
Guard on electric light made contact with fill pipe	1	
Details not given	5	
Tank repairing and cleaning operations	14	10
Torches igniting vapors	6	
Ignition while riveting or drilling	3	
Manhole cover removed, fumes ignited by other fires	2	
Dropped unguarded lamp ignited fumes	1	
Fumes ignited by gasoline pump motor	1	
Fumes ignited by spark from manhole cover	1	
Leaking or ruptured pipes	12	8
Exposure to fires in warehouse or other property	11	8
Tank filling operations	10	7
Allowed tank to overflow	6	
Static sparks	4	
Spark from electric switch or motor	9	6
Miscellaneous known causes	8	6
Total fires (known causes)	143	100
Explosions (causes not given)	16	
Unknown	17	
Total fires	176	

Amount of the Fire Loss.

Fire loss figures given for 113 of the 176 fires indicate a total property loss of $20,500,000, or an average loss per fire of $180,000. Table V shows the fires classified by amount of the loss. Significant of the oil tank hazard is the fact that only eight per cent of the fires caused damages of less than $5000 each, and that 50 per cent of the fires fall in the $25,000 to $100,000 class. Compared with the filling station fire record (January, 1937, QUARTERLY), for example, 58 per cent of the fires in that occupancy caused losses under $100 each. It is also significant that the nine largest loss fires resulted in losses totaling $13,500,000, which is about two-thirds of the total property loss in the 113 fires.

Table V. Fires Classified by Losses.

Loss	Number of Fires	Per Cent
Less than $5,000	9	8
$5,000 to $24,999	19	17
$25,000 to $49,999	28	25
$50,000 to $74,999	15	13
$75,000 to $99,999	14	12
$100,000 to $199,999	10	9
$200,000 to $499,999	9	8
$500,000 or over	9	8
Total (where losses are known)	113	100
Unknown	63	
Total fires	176	

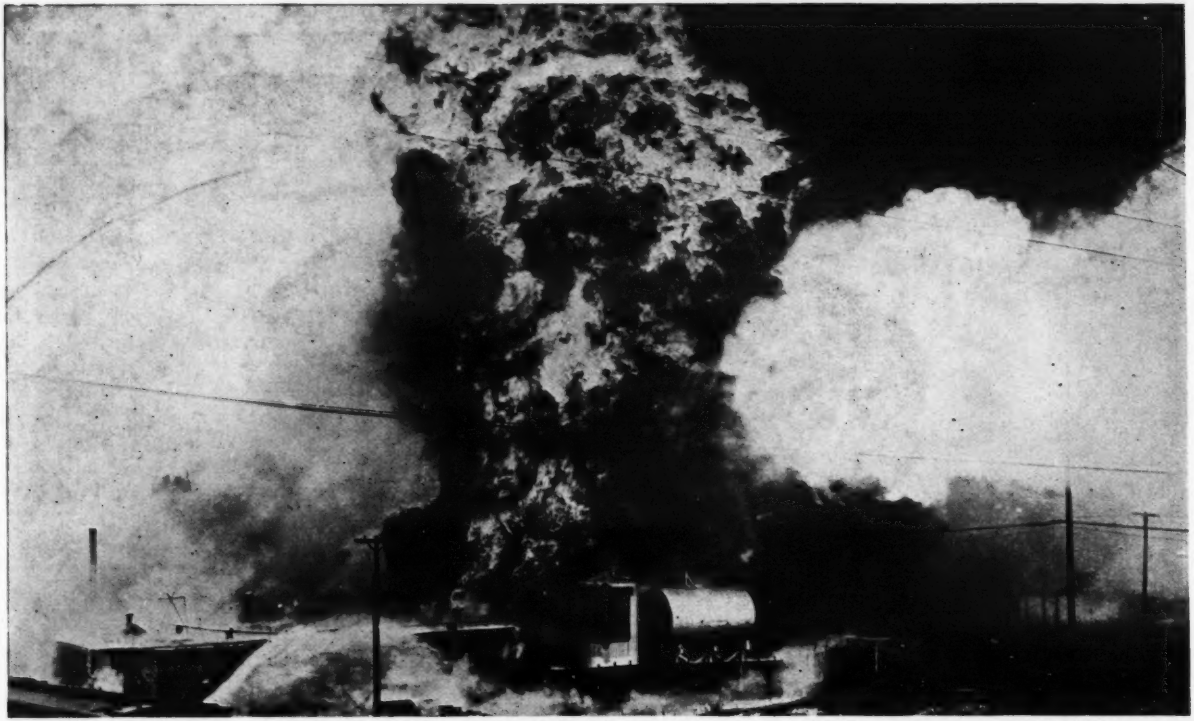
Fire Protection Facilities.

In addition to all-steel, gas-tight tank construction, other features of particular importance in aboveground storage properties as shown by this record are: separation from adjoining property, dikes, adequate venting facilities, proper separation between tanks, and adequate provision for fighting oil fires. Dikes or fire walls of adequate capacity would have prevented many of the large losses, particularly in connection with crude oil storage. Attempts to build emergency dikes were successful in retaining the flow of burning oil in only a few instances.

Inadequate vents were a factor in many of the large loss fires, and in practically all the explosions. High-powered rifles were used at a few fires to puncture small gasoline tanks having inadequate vents to relieve pressure created by fires around them. This is a practice of questionable merit.

Table VI shows the number of fires in which the various kinds of fire fighting equipment were used. Hose lines were used chiefly to keep adjoining tanks and other property cool, and thereby prevent the spread of the fire. Foam was used successfully in many of the fires, but all too often none was available, or there was so much delay in obtaining foam equipment and applying it to the seat of the fire that the foam was ineffective. In several instances explosions rendered the private foam equipment inoperative, or because of the sudden severity of the fire the use of foam would have been to no avail. It is common practice in the larger fire departments to have a foam generator and a supply of foam chemicals for use in combating oil fires, but smaller departments which are frequently called upon to fight fires in large oil tanks outside the jurisdiction of the larger fire departments are not always thus equipped. Many of the larger oil storage properties provide their own foam protection with fixed installations in tanks. (For tests of the use of foam on oil tank fires see the QUARTERLY for April, 1927, page 356; and for April, 1932, page 359.)

Crude oil usually contains some water and when the oil is heated in



St. Paul, Minn., May 19, 1924. This gasoline fire started when a tank car of casinghead gasoline was opened without proper precautions.

burning it may suddenly boil over, greatly increasing the hazard of fire in a crude oil tank as compared with the hazard in tanks containing other petroleum products. As indicated by accounts of typical fires in the last section of this fire record, boil-overs are common occurrences.

In at least 25 fires little effort was made to extinguish the fire and it was allowed to burn itself out. Firemen and employees concentrated their efforts in protecting other tanks or buildings and in pumping out and salvaging as much oil as possible. Some of the larger fires burned for several days before the oil was consumed.

Table VI. Fire Fighting Equipment Used.

Equipment	Number of Fires	Per Cent
Hose lines only	30	35
Foam only	18	21
Hose lines and foam	13	15
Hose lines and steam	6	7
Steam jets only	2	2
Hose lines, foam, and steam	5	6
No equipment used	12	14
Total (where data were given)	86	100
Data not given	90	
Total fires	176	

Loss of Life.

One hundred and eight lives were lost in the thirty-four of the fires covered in this record in which loss of life occurred. This means that one out of about every five gasoline and oil storage tank fires reported to the N.F.P.A. Department of Fire Record resulted in the loss of at least one life. The average number of lives lost in these 34 fires was about three persons per fire. These figures forcibly indicate the seriousness of the risk taken by firemen when fighting fires in oil tanks. Four typical examples of loss of life fires are given below and others are included in the list of typical fires which follows.

Six Killed While Cleaning Inside of Tank.

MARRERO, LA., AUG. 19, 1918. Six men on a scaffold about ten feet high were cleaning the inside of a new riveted-steel tank preparatory to using the tank for storage of gasoline. The work was about to be completed and the foreman asked that water be pumped into the tank to float out the scaffold timbers through a manhole in the side. An employee who was not familiar with the valves opened the valve in a pipe connected with the gasoline discharge system instead of opening the valve in the water line. This allowed gasoline to flow into the tank where the men were working. The mistake was soon discovered, and water was pumped into the tank. In the meantime a large quantity of gasoline had entered the new tank. One of the workmen lighted a match and the gasoline vapors exploded, killing all six men. (H-14515.)

Lightning Strikes, Bursting Tank Kills Three Men.

SALT LAKE CITY, UTAH, JUNE 11, 1921. During a heavy thunderstorm lightning struck a tank containing gasoline. This was the only tank with a wooden roof in the group of eight tanks. The resulting fire spread rapidly, involving all the tanks. One tank was weakened by the heat and burst, killing three men and injuring several others. The fire burned for 22 hours and caused a property damage of $246,000. (H-17559.)

Seven Firemen Fall into Tank of Oil.

PITTSBURGH, PA., JAN. 21, 1924. Two firemen were on a 40-foot extension ladder which had been put in position at one corner of a fire wall surrounding a battery of ten oil tanks. The ladder extended eight rungs above the top of the wall and without warning it snapped where it rested against the top of the wall, hurling the men down on the top of an oil tank about 16 feet in diameter and 20 feet deep. The tank had a wooden top on which a number of men were standing. The impact caused a section of the roof to break through, and the two firemen with five other firemen fell into the tank, which was partly filled with oil covered with a heavy layer of foam. All seven men died before aid could reach them. The fire was comparatively small — starting in some oil which leaked from a pumping-out line from the adjoining stills of the refinery. (H-20259.)

Explosion Kills Watchman and Pedestrian.

OIL CITY, PA., SEPT. 15, 1935. Flammable vapors discharged from an oil storage tank were ignited at some tube stills across the street. This caused a violent explosion, which blew the roof off the tank and ignited its contents. The plant watchman was killed by the explosion and a pedestrian was so badly burned that he died later. The tank and contents were destroyed, but through the efficient use of foam and hose streams by the fire department and employees only slight damage was done to three other tanks. The property loss was estimated at $10,000. (H-40105.)

Typical Storage Tank Fires.

Aboveground storage tanks of proper design and construction, correctly located, and provided with dikes or fire walls to prevent the flow of oil towards adjoining property in case of leakage of the tank as recommended by the N.F.P.A. Suggested Ordinance Regulating the Use, Handling, Storage and Sale of Flammable Liquids present no unusually serious hazards. These regulations are designed to provide reasonable public safety without imposing undue burden upon the oil industry or the public and are the recognized guide to good practice in the control of storage tank fire hazards. They have been made the basis for many municipal ordinances and regulations. As indicated by the following typical examples of oil storage tank fires, failure to provide safeguards as set forth in these regulations results in most of the fires and the largest losses.

Exploding Tank Kills Ten and Injures Thirty-Six.

HAYS, KANS., Nov. 17, 1919. When an employee attempted to crank a truck in the supply house of an oil storage plant, the engine backfired and enveloped the man in flames. The flames spread to three large storage tanks which had inadequate vents. One tank exploded; parts were blown 462 feet. A crowd had gathered to watch the spectacular blaze, and when the tank exploded ten people were killed and 36 others were severely injured. The total property loss was about $100,000. (H-16090.)

Conflagraton Destroys Seven Tanks and Nineteen Buildings.

BALTIMORE, MD., JULY 19, 1920. Lightning struck two steel tanks with wooden roofs belonging to a refinery. One contained 55,000 barrels of distillate and the other contained 55,000 barrels of crude oil. It was reported that steam jets had been in operation for an hour before the tanks were struck, but apparently there was not sufficient steam in the tanks to prevent ignition and the resultant explosion caused the tops to be blown from the tanks and then to settle down inside. The suction pipes inside the tanks were disabled by the falling roofs, which made it impossible to pump oil from the tanks. However, if this had been possible, there were no empty tanks available into which the oil could have been pumped. This territory (East Brooklyn) had recently been annexed to Baltimore and had no public water supply. The refining company, however, had a private system, consisting of 14 hydrants. After about nine hours the tanks partly collapsed and the boiling oil spread quickly over the dikes, imperiling the lives of hundreds of firemen, spectators, and inhabitants. The flaming oil ignited everything in its path, destroying almost every foot of fire hose being used, putting fire apparatus out of service, and stopping only at the water's edge. With the fire department helpless, the fire destroyed three tanks and the sample house and garage belonging to the refinery. In addition, four tanks of an oil company, the East Brooklyn Volunteer Fire Department headquarters, fifteen dwellings, and two retail stores were completely destroyed in the conflagration. The fire burned for four days. The tanks were too close together and too near the dwellings, and the dikes had a capacity smaller than that of the tanks. (H-16633.)

Tank Farm Struck by Lightning Four Times in One Month.

CASPER, WYO., JUNE-JULY, 1921. Lightning struck one tank farm four times during the month from June 17 to July 18, 1921. The resulting fires involved 11 steel tanks with wooden roofs of 55,000 and 80,000 barrel capacities. The total damage was estimated at $1,146,000. (H-17605.)

On June 17 seven tanks were ignited instantaneously and 346,712 barrels of oil were destroyed; 49,670 barrels were saved with pumps. The loss was $250,000 to tanks and $596,000 to oil. All the tanks were of steel construction with wooden roofs covered with tar and gravel. Roofs were not tight and not provided with vents. The tanks were only recently completed and no dikes had been built, and pipe line ditches to tanks had not been filled. The tanks were 285 feet apart and were entirely without fire protection facilities. Employees immediately built emergency dikes and firemen protected exposed tanks. A small cannon was used to puncture all of the burning tanks to distribute the oil over the ground rather than to allow it to boil over and thus be more likely to spread fire. The fire burned itself out in 48 hours.

St. Paul, Minn., May 19, 1924. Ruins of the gasoline fire which took two lives and destroyed nine storage tanks. Note the general congestion of the plant.

On July 2 lightning ignited a tank containing 53,500 barrels of crude naphtha, and within four minutes the foam system was in operation. Within nine minutes foam was projected on the burning oil and after the mixing chambers had operated for 20 minutes the fire was practically extinguished. Only about $6000 damage was done to the tank and contents valued at $265,000.

On July 12 a direct stroke of lightning ignited an 80,000 barrel tank filled with crude oil and not having any protection against fire or lightning. About 28,500 barrels of oil were pumped out. Efforts to pump water into the tank with the idea of forming steam to shut off oxygen from the fire only intensified boiling, and efforts to rig up an emergency foam connection were not very successful because of the time consumed, the distance to the foam station, and because an effective connection to the tank could not be secured.

On July 18 lightning ignited two more tanks, but at this time a pipe line from the foam system was under construction. Temporary connections were made from this line to one tank, and after much difficulty foam was introduced into the tank and the fire extinguished. The other tank was allowed to burn itself out because of the danger of exhausting the already diminished supply of chemicals.

No Protection, Tanks Too Close, Two Burned to Death.

ST. PAUL, MINN., MAY 19, 1924. As a state oil inspector and an employee of a refining company loosened the cover on a tank car of casinghead gasoline, the cover blew off and the vapor ignited at the refining plant boiler stack 50

feet distant. The men were unaware of the nature of the contents of the car, and it was stated that the car was not properly placarded and that the pressure gauge did not function. The two men escaped with minor injuries, but two other employees standing about 50 feet from the car were burned to death when their clothing caught fire. Fire, following three explosions, completely destroyed the plant, which consisted of nine storage tanks and a number of gasoline drums. This oil plant had no fire protection of any kind and the tanks were close together and not provided with dikes. The buildings were not cut off from the oil storage area. The fire department used 13 hose streams in preventing the spread of the fire to surrounding property. The damage was estimated at $90,000. (H-20747. See July, 1924, QUARTERLY, page 98.)

Collapse of 80,000 Barrel Tank of Crude Oil Causes $196,000 Fire.

PONCA CITY, OKLA., DEC. 19, 1924. Two 80,000 barrel steel tanks of fresh crude petroleum on an oil tank farm outside the city were destroyed by fire. It was believed that due to climatic or other conditions one of the steel shell sheets in the first ring of one tank crystallized, resulting in a small aperture in the shell near the ground level. A widening of this opening occasioned by the sudden outrush of oil probably caused a partial collapse of the tank, causing rivets to be sheared or other metallic friction which set up a static spark in the vapor-charged atmosphere surrounding the tank. An immense volume of oil shot out in one direction and passed over the 9-foot earthen dike and over some of the dike walls surrounding eight other 80,000 barrel gas-tight tanks. Seven of these other tanks were filled with crude oil. The eighth tank contained only a few feet of oil, and flame passed into it either by igniting vapor discharging from some point in the shell or roof, or by a rupture from the impact of the oil from the first tank. The fire was fought by employees. A loss of $196,000 was reported. (H-21702. See April, 1925, QUARTERLY, page 381.)

Blazing Gasoline from Bursting Tanks Causes Three Deaths.

MT. VERNON, OHIO, SEPT. 14, 1925. As an employee was filling a tank truck there was a flash and the whole back of the truck and loading rack was in flames. The fire quickly involved a small gasoline tank and two other tank trucks stored in a shed. Heat made the gasoline boil in several large tanks, and soon the vapors ignited. Firemen turned water on the red hot tanks, which burst and showered blazing gasoline into the air and over the firemen. They dashed into a river which flows near the plant and two of them lost their lives. A boy, who was assisting the firemen, became entangled in weeds along the river and died before he could reach the water. (H-22445.)

Largest Oil Fire in History, $7,000,000 Loss.

SAN LUIS OBISPO COUNTY, CALIF., APRIL 7, 1926. Three concrete-lined earth reservoirs on a storage farm were simultaneously ignited by lightning. The farm also contained three other reservoirs and nineteen 55,000 barrel steel tanks with wooden roofs. The first boil-over occurred after 17 hours of burning, and by the third day the fire had spread to all the reservoirs and to fourteen of the nineteen tanks. The fire burned for five days and destroyed approximately 5,000,000 barrels of oil valued at about $7,000,000. In addition, two men were killed, five cottages burned, two farmhouses destroyed by blasts of wind caused by the explosions of the reservoirs, plate glass windows in

San Luis Obispo, Calif., April 7, 1926. The largest oil fire in history began when lightning ignited three large reservoirs on this 300-acre tank farm. It burned for five days and destroyed 14 large tanks, five million barrels of oil and several buildings. Two men were killed.

Baltimore, Md., Aug. 10, 1926. View of the fire about an hour after it started, while a tank truck was being filled. The tank truck driver was killed and twelve tanks were destroyed.

stores two miles away in a straight line were broken, and oil flowed to the ocean nine and one-half miles away by the way of a creek. (H-23405. See July, 1926, QUARTERLY, page 87.)

Lightning; Steam Jets Extinguish Fire.

TITUSVILLE, PA., JUNE 14, 1926. Lightning struck and ignited a storage tank located in an oil refinery and containing 476 barrels of gasoline. The tank was of all-steel construction, but not entirely gas-tight. It was equipped with four 2-inch steam jets and one 3-inch. These jets were put into service immediately and the blaze was smothered in about 15 minutes. Gasoline was drawn from the tank to one more distant and the resultant loss was only about five barrels of gasoline. Foam was kept in readiness, but its use was not necessary. (H-23744.)

Tank Truck Filling; No Proper Vents or Dikes.

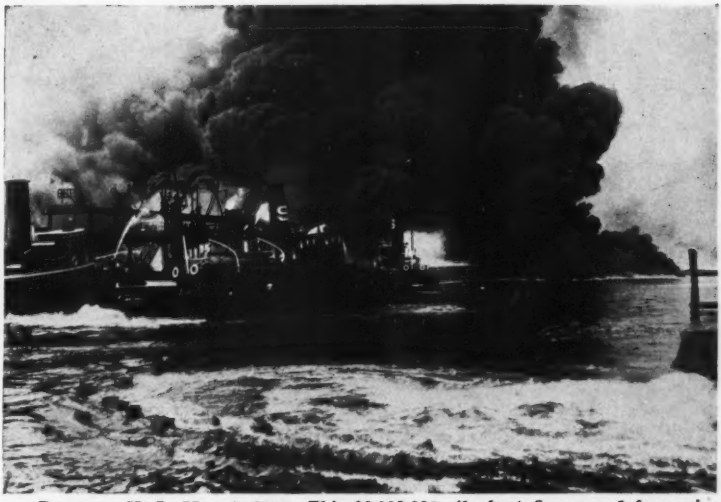
BALTIMORE, MD., AUG. 10, 1926. A fire which originated from an undetermined cause while a tank truck was being filled through a gravity connection, completely destroyed 12 tanks and the warehouse of a distributing station and killed the tank truck driver. Eight tanks were of the horizontal type, of capacities ranging from 2000 to 20,000 gallons each, and four tanks were

Bayonne, N. J., May 8, 1930. Blazing oil tanks following an explosion aboard a motor tanker.

vertical, with capacities from 16,000 to 42,000 gallons each. Apparently the gravity filling arrangement allowed burning gasoline to spread rapidly to the entire group of tanks, which were neither properly spaced nor properly diked, and were not equipped with adequate vents. Forty-three engine, truck, and hose companies responded to the six alarms sent in for the fire and rendered good service in surrounding the group of tanks with a curtain of water. The horizontal tanks collapsed, but the vertical ones remained intact. The brick walls and dikes were light, poorly constructed, and of small capacity. They generally failed. The plant included one additional tank containing 42,000 gallons of benzol, which was detached from the others and was saved by playing hose streams on it. Foam was used to check the blazing oil as it flowed on the water, but neither the hose streams nor the foam were effective as extinguishing devices for a fire of this type and proportions. (H-23647. See October, 1926, QUARTERLY, page 190.)

Piping Not Safeguarded.

NEW ROCHELLE, N. Y., OCT. 31, 1927. Two all-steel tanks of 56,000 and 59,000 gallons capacity were being filled by pumping from a barge. The fire department was notified shortly after 6 P.M. that one tank was overflowing, and before a fire department officer arrived to investigate, an explosion occurred in the pit around the two tanks. This dike or pit was of such a depth as to form a pocket not readily cleared of vapors by normal air currents. The source of ignition was not definitely determined. The two tanks were too close together to permit the erection of separate dikes, hence a single rectangular, reinforced concrete dike enclosed both tanks. Both tanks were equipped with a foam system — the power line to the pumps being overhead and in close proximity to the tanks. The explosion destroyed this power line and it was some time before an emergency line was established and foam was discharged



Bayonne, N. J., May 8, 1930. This $2,000,000 oil plant fire spread from pier to pier by burning gasoline carried by ebb tide under wharves and against piling.

Bayonne, N. J., May 8, 1930. Tanks supported on wooden piling toppled over when foundations burned away, adding their contents to the fast spreading flames.

into the tanks and pit. A portable foam generator from a near-by city was also used. Apparently foam was not as effective as it might have been because hose streams were played into the pit at the same time. The explosion apparently had broken the pipe lines leading into the bottom of the tanks. While

Ripon, Wis., May 24, 1930. In the center are the oil tanks at the height of the fire. Across the tracks are the ruins of the knitting works building, and in the foreground are ruins of the woodworking plant. In the left foreground are a large cabbage storehouse and an electric sub-station, which escaped destruction.

considerable internal pressure was created in the tanks the venting facilities provided were evidently sufficient to safely relieve it. (H-25088. See January, 1928, QUARTERLY, page 281.)

Lightning Causes Explosion of All-Steel Tank.

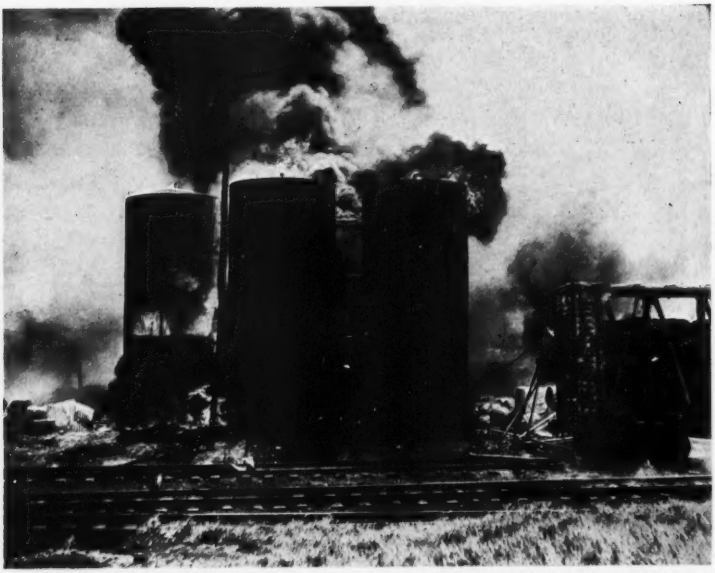
McCANDLESS TWP., PA., JULY 7, 1929. Lightning struck one of eight all-steel tanks containing crude oil on a tank farm. A large hole was ripped in the top of the tank and the resulting explosion of gases in the tank lifted the top and dropped it into the tank, wrecking the lift valves and making it impossible later to drain the tank. Lacking equipment to fight this oil tank fire, six volunteer fire companies from near-by communities concentrated their efforts in keeping the other seven tanks cool with water drawn from an adjacent creek. The following day the top half of the burning tank became almost white hot and buckled, allowing the oil to boil over. The burning oil flowed over the 13-foot dike and when it reached the creek the firemen had to stop their operations. The damage was confined to the one tank and its contents, amounting to about $75,000. (H-30600.)

Tank Boat Fire Spreads to Oil Terminal and Refinery, $2,000,000 Damage.

BAYONNE, N. J., MAY 8, 1930. Fire started by backfire on a small motor-driven tank boat did approximately $2,000,000 damage before it was finally brought under control. It destroyed three piers, a barrel house, 18 oil storage tanks with capacities from 418 to 10,630 barrels, containing 5,000,000 gallons of gasoline and fuel oil, a power house, pump houses and a number of other structures. The tank boat, of 9000 gallons capacity, had just been filled with gasoline, when an attempt to start the gasoline engine resulted in a backfire which ignited gasoline vapor that may have been present in the engine room. The fire on the boat and flames from burning gasoline on the water rapidly spread the fire to piers, buildings, and oil tanks. Exploding drums of oil and gasoline assisted in the spread. Tanks supported on wooden platforms and piling soon gave way, but dikes around this area were adequate and no boil-over of crude oil occurred. Combined public and private fire fighting forces did excellent work in applying foam on the burning oil and keeping buildings and adjacent gasoline tanks cool with water. Over 400,000 gallons of foam solution and over 100,000 pounds of foam powder were used. (H-29524. See July, 1930, QUARTERLY, page 51.)

Explosions Destroy Two Manufacturing Plants.

RIPON, WIS., MAY 24, 1930. An explosion occurred shortly after a runaway horse broke a small pipe leading into one of the six 15,000 gallon oil and gasoline tanks of a bulk oil station. This explosion wrecked the office and warehouse of the oil company, and subsequent explosions of tanks destroyed a wooden handle manufacturing plant on one side and a knitting works across the railroad tracks. The tanks were too close together, too near the railroad tracks, inadequately vented and no dikes were provided. The vapors probably ignited from the fire box of a freight engine about 400 feet away. Flames quickly destroyed the warehouse and communicated to the storage tanks. Gases burned intensely from the vents, which consisted of 2-inch pipes terminating in an elbow leading downward and were not equipped with screens. Firemen devoted their attention to protecting adjoining buildings. One tank



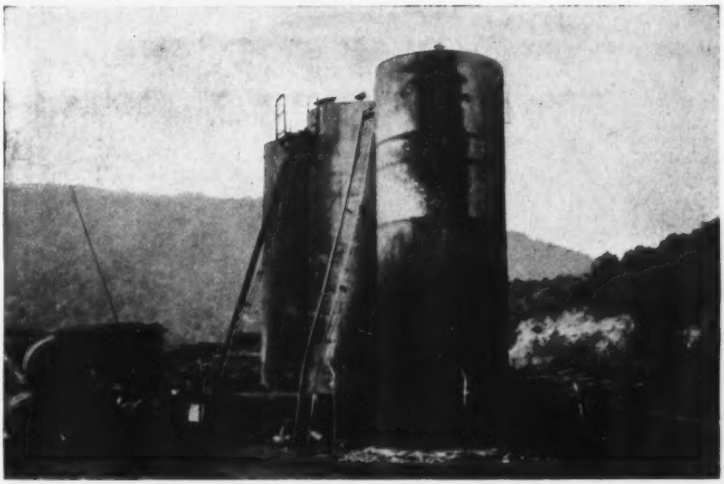
Ripon, Wis., May 24, 1930. Close-up of the burning tanks. A typical example of disregard of safeguards; tanks too close together, too near railroad tracks, inadequate vents and no dikes.

contained kerosene, and when it exploded a fireman was trapped between the tank and a near-by residence. He died the following day from severe burns. The loss was about $85,000. (H-30004. See July, 1930, QUARTERLY, page 105.)

Non-Vaporproof Switch, Indiscriminate Use of Foam and Water Streams.

BALTIMORE, MD., MAY 30, 1931. Fire started under a concrete platform which supported some filling tanks at an oil distributing plant. Ignition might have been by static sparks, as a thunderstorm was passing over the city, or it might have been caused by an employee who had just finished filling several small tanks and had shut off the gasoline pump, which was controlled by an ordinary electrical switch under the platform. It is thought that gasoline overflowed and accumulated under the platform. There were 16 all-steel tanks with inadequate vents located in a natural depression in the ground. They contained gasoline, benzol, kerosene, and fuel oil. The heat of the fire affected all of the valves and pipe connections under the platform and caused leaks which supplied additional fuel for the flames. The fire department responded with 51 pieces of apparatus and used its entire supply of 20 tons of foam powder and a large number of hose streams. It was impossible to segregate the fire in any of the 16 tanks, as foam and water streams used simultaneously produced unfavorable results when the water broke up the film of foam. The fire was not extinguished until practically all of the oil storage in the 16 tanks

Rowlesburg, W. Va., Aug. 1, 1931. A gasoline truck coasted off the filling platform at this distributing station and ruptured the discharge valve on one tank as shown in the center picture. This allowed gasoline to escape and become ignited by a rubbish fire 150 feet away. Not being confined by dikes, the burning gasoline spread to lumber piles beyond and at the right of the tanks, as shown below after the fire. The contents (17,000 gallons) of one tank burned, but the others burned only from the vents, as shown above. (H-33781. See Jan., 1932, Quarterly, p. 321.)



Long Beach, Calif., June 2, 1933. Airplane view of the half million dollar fire which resulted from the failure of a horizontal steel storage tank of gasoline.

was consumed. The department was successful in preventing damage to six other tanks of 65,000 gallons capacity each in the diked area at a slightly higher elevation. The loss was estimated at $30,000. (H-32637.)

Work on Tank Containing Gasoline; Explosion.

BRIDGEPORT, CONN., OCT. 5, 1931. While an electric drill was being used to drill a hole near the top of a gas-tight gasoline tank for installation of foam apparatus, a spark or hot chip caused an explosion which ruptured the top and bottom of the tank and ignited the gasoline inside. The tank was about one-third full. The fire in the tank was soon extinguished with a public foam generator, and the remaining gasoline was drawn off into trucks and stored elsewhere. The damage was estimated at $5000. The concrete dike surrounding the tank limited the spread of the leaking gasoline. (H-33780.)

Foam Extinguishes Fire While Firemen Protect Exposures.

MIDDLETOWN, N. Y., DEC. 22, 1931. Employees were draining gasoline from a 60,000 gallon all-steel gas-tight tank, and in order to drain the last few inches it was necessary to remove the manhole cover near the bottom. While unscrewing this cover it was found that the gasoline level was higher than expected and a quantity of it spilled. It was believed that the cover or a wrench was dropped, causing a spark which ignited the gasoline vapors. While

2½-gallon foam extinguishers were being used on the fire, an explosion occurred in the tank. The explosion blew off the light dome-shaped top and blew flaming gasoline out through the manhole and on the group of men who were attempting to extinguish the original fire. The fire department directed hose streams on adjacent tanks to keep them cool while a portable foam generator was being set up. The foam was then directed into the burning tank by a fireman perched on an aerial ladder and soon the fire was extinguished. About three-quarters of a ton of foam powder was used. Gas-tight steel tanks close by, containing kerosene, fuel oil, and gasoline, did not ignite. The loss was about $2000. (H-34129.)

Distributing Station Fire Destroys Three Tanks and Six Cottages.

HARRODSBURG, KY., JAN. 25, 1932. A careless attendant, who was pumping gasoline from a tank car to a storage tank, went away and for 15 minutes the storage tank overflowed, causing gasoline to run down a near-by creek toward the business section of the town. Two small boys who noticed the gasoline on the water were curious to know whether or not it would burn and threw a match in it. Fire flashed back and destroyed the tank. Before the fire was stopped by building a dam of sacks of grain, three 10,000-gallon storage tanks, two warehouses, and a half dozen cottages were burned. There were no dikes around the tanks. The loss was estimated at $75,000. (H-34294.)

Spark from Welding, No Dikes, No Foam, Inaccessible Valves.

ST. PAUL, MINN., AUG. 19, 1932. Two men were welding a 100,000-gallon steel tank, which was about eight feet from a warehouse of a refining company. The warehouse was set on piles about one foot above the ground, and it was thought that a spark from the acetylene torch got under the floor of the warehouse and ignited some old lumber stored there. By the time the fire department arrived the fire had swept through the warehouse and ignited tanks of distillate fuel oil. Near the warehouse were 15 vertical and horizontal tanks of gasoline, fuel oil, and kerosene of capacities from 16,000 to 100,000 gallons each. This property was situated in a rather low area and water soon carried burning oil around and under the tanks. The intense heat broke pipe connections and released more fuel for the fire. None of the tanks were diked and several of them were connected by pipes with shut-off valves in inaccessible places. There were no first-aid fire appliances on hand except a few soda-acid extinguishers. In spite of the difficulties it encountered, the fire department confined most of the loss to the warehouse, four tanks, and about 205,000 gallons of gasoline and oil. The loss was about $50,000. (H-35682. See October, 1932, QUARTERLY, page 165.)

Ruptured Tank, Nine Killed, Private Fire Equipment Rendered Inoperative.

LONG BEACH, CALIF., JUNE 2, 1933. Failure of a horizontal steel storage tank of unstabilized casinghead gasoline was responsible for the loss of nine lives and a property loss estimated in excess of $500,000 at a gasoline absorption and compressor plant. The verdict of the coroner's jury was that the failure was due to overfilling the tank, thereby releasing its contents, which were subsequently ignited. Two explosions and the resulting fire wrecked the plant, derricks, storage tanks, and other equipment. The plant was located between a residential section and an oil field. Approximately 50 residences,

Tiverton, R. I., Nov. 1, 1933. Airplane view of the fire two hours after it started, when a new 80,000 barrel tank (extreme left) collapsed and killed three men. The fire is shown burning at the pump house and in the diked area around two 10,000-barrel tanks.

Tiverton, R. I., Nov. 1, 1933. View of the $700,000 fire about six hours after its start. The other four tanks shown in the foreground of the foregoing picture are now involved. Nearly five million gallons of gasoline, kerosene, and fuel oil were destroyed. The dwelling at the left, 175 feet from the nearest burning tank, was not damaged. Note pigeons on roof.

Tiverton, R. I., Nov. 1, 1933. Upper picture shows a foam stream in operation. Lower picture shows men carrying containers of foam powder. The rate of foam application was totally inadequate for a fire of this magnitude.

offices, and stores were damaged. Seven of the nine persons who lost their lives were employees of oil companies and two were occupants of a near-by dwelling. Four public fire departments and fire crews of oil companies fought the fire with foam and water. Private fire protection at the plant included two portable dry powder foam generators and 5200 pounds of dry chemicals, but due to the suddenness and violence of the explosion, this fire fighting equipment was rendered inoperative. (H-37125. See October, 1933, QUARTERLY, page 141.)

Tank Being Tested Collapsed, Three Killed.

TIVERTON, R. I., Nov. 1, 1933. A marine oil terminal was largely destroyed by fire that followed the collapse of a new 80,000 barrel tank which had been filled with sea water for testing. Three men were killed in the collapse of the tank. The fire burned for several days, destroying nearly 5,000,000 gallons of gasoline, kerosene, and fuel oil, at a loss estimated at $700,000.

There were eight vertical tanks, ranging in capacity from 10,000 to 80,000 barrels each. These tanks were surrounded by earthen dikes 14 to 15 feet high and enclosing sufficient area to hold the entire contents of the tanks. A pump house of light construction was located in one of the dikes at a vital point in the center of the property, the dike being discontinuous at this point. In addition there were four horizontal loading tanks of 500 barrels capacity each. For the most part all 12 tanks were only partly full. One 80,000 barrel tank, half full of kerosene, was the only one not destroyed in the fire. It is significant that this tank was the only one properly spaced and equipped with vents of approved type with adequate capacity.

The force of the water from the collapsed tank overtopped the dike and together with the débris carried with it apparently ruptured piping which was laid on the top of the ground without special protection. Gasoline and oil were released, and at the same time it appears that electric pumping equipment in the pump house between the dikes was affected. This condition obtained for about 10 or 15 minutes after the tank collapsed before the start of the fire. Dikes soon broke and while the tanks were of all-steel construction with gas-tight roofs, all but one were soon involved, owing to the severity of the exposure fire. There was no foam or other equipment suitable for fighting oil fires available either at the plant or in the equipment of the fire companies that first responded from Tiverton and Fall River, and the fire was practically beyond control from the start. Foam equipment arrived later from near-by cities, and four tank cars of foam solution were brought from another oil storage plant. Two foam streams were put into operation, but were ineffective to control a fire of such large area. The firemen then confined their efforts to the protection of exposed property. (H-37761. See January, 1934, QUARTERLY, page 203.)

Rupture of Inadequately Vented Gasoline Tanks Causes Seven Deaths.

JAMESTOWN, N. Y., JUNE 18, 1934. Four firemen and three spectators were burned to death, several were critically burned, and a hundred or more people suffered burns when two gasoline tanks exploded during a fire in a bulk oil distributing plant just outside the city limits. The fire started in a pump house from ordinary electrical equipment, not suitable for use in the presence of flammable vapors. The casualties occurred when two horizontal tanks, inadequately vented, suddenly ruptured from internal pressure generated by the heat of burning gasoline on the ground. One tank had a capacity of 10,000 gallons and the other 20,000 gallons, and both were constructed of steel of adequate thickness. Each tank had a 2½-inch vent, and according to the N.F.P.A. Suggested Flammable Liquids Ordinance, such vents on tanks of this capacity would permit generating an internal pressure of about 25 pounds per square inch under assumed fire conditions. One pound per square inch is stated as a conservative pressure to allow for ordinary horizontal tanks. A vent about 5½ inches in diameter is required to limit the pressure to one pound per square inch in a tank of from 10,000 to 20,000 gallons capacity. No dikes were provided around the tanks because of natural drainage away from exposed property. A third tank, of 20,000 gallons capacity, was burning at a broken pipe which was spraying gasoline, due to internal pressure. It was also burning at the gauge hatch. High-powered rifles were used to make 33 bullet holes in this tank to relieve the pressure. This was only slightly effective and two minutes later the entire manhole blew off. (H-38602. See July, 1934, QUARTERLY, page 53.)

Jamestown, N. Y., June 18, 1934. Seven men were burned to death and many injured when two gasoline tanks (wreckage in foreground) exploded, due to inadequate vents. The 20,000 gallon tank in the middle background is burning at the manhole and at the end punctured by rifle bullets in an attempt to relieve the pressure. At the right is the shell of the 10,000-gallon tank blown 45 feet from its original position.

Colton, Calif., July 11, 1935. An employee was burned to death in the fire which followed when he operated the non-vapor-proof electrical switch to stop the pump after this tank overflowed. The switch and pump were under the tank, which stood on a wooden platform. The tanks were of light corrugated iron construction with soldered joints.

Substandard Corrugated Iron Tanks on Wooden Platforms.

COLTON, CALIF., JULY 11, 1935. A transport truck was discharging gasoline into a corrugated iron storage tank that stood on a wooden platform at a distributing plant. Under the tank was a centrifugal motor-driven pump and electrical control switch. It was believed that the tank overflowed and that the night attendant, who was in charge, operated the cut-off switch in order to stop the flow, instead of closing the suction valve to the pump. Fire immediately followed, enveloping this distributing plant and two others. The attendant received burns from which he died three days later. Substandard construction of the several tanks and the use of wooden platforms for foundations made the control of this fire practically impossible. Failure of the wooden supports and the opening of soldered seams in the tanks caused rapid spread of the flames. Approximately 100,000 gallons of gasoline and oil were destroyed, and the loss was estimated at $40,000. (H-40011. See October, 1935, QUARTERLY, page 122.)

Careless and Illegal Handling of Flammable Liquids.

BALTIMORE, MD., JULY 11, 1936. An explosion of benzol vapors occurred in a 4-story ordinary brick joisted building used for wholesale distribution of various flammable liquids. This explosion probably broke a benzol pipe line or storage tank and the large volume of benzol then exposed provided fuel for a second and more violent explosion. These explosions and fire which followed resulted from the careless and illegal handling of flammable liquids which

Baltimore, Md., July 11, 1936. Blazing ruins of a wholesale flammable liquids distributing plant in which four persons lost their lives. Explosion of vapors from flammable liquids, which were stored on the premises without a permit from city authorities, started the fire. Benzol was being unloaded from the tank car at the right when the explosion occurred.

were stored on the premises in spite of previous refusal of city authorities to grant a permit for this storage. Storage apparently was in six tanks of about two to eight thousand gallons capacity each. The cause of the ignition is not known. Firemen, upon arrival, found intense flames raging throughout this building and the adjoining 2-story building occupied by a wholesale paper dealer. Four persons were killed and six firemen were injured. Through efficient work of the fire department, the fire was confined to the two buildings. (H-41050. See October, 1936, QUARTERLY, page 162.)

Inadequate Vents and Dikes, No Public or Private Foam Equipment.

ATLANTIC CITY, N. J., JULY 16, 1937. Fire, thought to have been caused by a cigarette tossed on the ground that was soaked with gasoline from a leaking tank or piping, did damage of about $75,000 to a combination oil storage and service station plant; and when the top of a large kerosene tank gave away, 60 firemen and 140 spectators were injured by the blast of flame. The fire started either in or near the pump house or near the filling station building, and within two minutes involved the entire plant, which included four vertical gasoline, kerosene, and fuel oil tanks of moderate capacity, the largest holding 19,800 gallons. These tanks were enclosed in a steel dike about 12 feet high, which was not in accordance with the N.F.P.A. Suggested Flammable Liquids Ordinance that calls for concrete or earth dikes having sufficient capacity to hold the contents of the tanks. No foam protection had been provided. Neither did the public fire department have equipment for foam hose streams or any other special equipment to combat large oil fires. The single 1½- and 2-inch vents provided in the tanks were barely sufficient to permit the normal inflow and outflow of air during filling and emptying, and there were no emergency vents to relieve pressure under fire conditions as specified in the Suggested Ordinance. (H-41905. See October, 1937, QUARTERLY, page 127.)

Adequate Spacing and Dikes, Inaccessible Valves, Inadequate Protection.

CENTER BRIDGE, PA., AUG. 20, 1937. Two 35,000-barrel steel tanks of a bulk storage and pipe line booster plant were struck simultaneously by lightning. The two tanks were of the cone-shaped, wood roof covered with sheet iron type of construction and contained about 24,000 barrels of crude oil. One soon ruptured by explosion and the other did so after burning for five hours. Tank-pump intake control valves located in the dike area were inaccessible from the start. Their operation, however, would have been of no value, as the same storm put the electric substation, several miles distant, out of service. Several volunteer fire companies drafted water from the near-by navigation canal and protected two 30,000 barrel tanks of crude oil and two 10,000 barrel tanks of gasoline which were exposed to the fire. Neither the oil company nor the fire companies were equipped for foam generation. Apparently all six tanks were adequately spaced and diked, and the loss of about $82,000 was confined to the two tanks which were struck by lightning. The oil company reports that all new tanks built or old tanks reroofed by them in recent years have been of all-steel, gas-tight construction, none of which have been struck by lightning. (H-41909.)

Self-Closing Valve Failed to Operate, Poor Handling of Fire.

SAN FRANCISCO, CALIF., SEPT. 22, 1937. The driver of a small truck upon which was mounted a 250-gallon square tank had loaded the tank with

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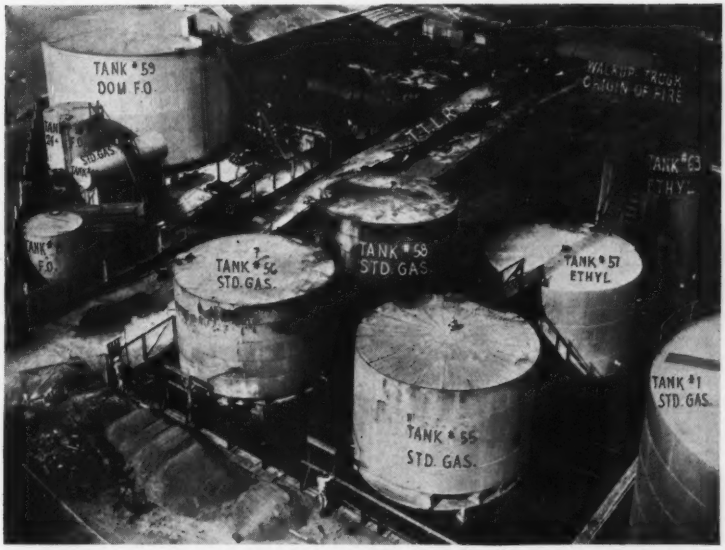
Center Bridge, Pa., Aug. 20, 1937. Fire destroying two large tanks of crude oil after lightning struck them. Apparently all six of the tanks at this bulk storage plant were properly spaced and diked.

about 75 gallons of gasoline at the loading rack of a distribution station, when a flash occurred at the fill opening, knocking him off the side of the truck where he was standing and holding the valve open. Being on the far side of the truck from the loading rack, he could not readily close the valve in the riser and probably was too excited to do so. The self-closing valve for some unknown reason remained open. The driver was alone, as the loading rack attendant was in the office with another customer. Apparently all reasonable precautions against static electricity had been taken.

The loading rack man rushed out and picked up an extinguisher, but finding the blaze too large for the extinguisher, he pulled the nearest fire alarm box. As loading occurs at the rate of about 275 gallons per minute, the tank quickly overflowed and burning gasoline flowed along the rack which extended along the center of an alley between two sections of the bulk storage yard, making a very large fire by the time the fire department arrived, which was probably about ten minutes after the fire started. The fire department attempted to control the flow of gasoline by flushing it with water streams. No attempt was made to shut off the supply to the loading rack until the arrival of the plant foreman, who followed the fire department to the scene. One or more of the 8-inch headers under the loading rack burst from expanding oil trapped between two closed valves. This released a large quantity of oil, which caused the fire department to retreat and temporarily abandon their water tower in the street and in the path of the oil. The truck was badly burned.

After the valves were closed the fire finally burned itself out, but in the meantime it had destroyed the can house, gauger's house, fuel oil pump house, barrel platform, and machine shop on one side of the alley, and caused a leak in a valve on a 1300-barrel tank which was over half full of gasoline on the



San Francisco, Calif., Sept., 22, 1937. View showing where the fire started at the tank truck loading rack in the alley. Over 600 barrels of gasoline were lost from tank 58. Tanks 55, 56, 57 and 63 were also involved. Improper spacing and other features not in conformance with recognized safety requirements may be noted.

other side of the alley. Burning gasoline sprayed from this leak made an intense fire which exposed four other tanks of similar size, construction, and contents, which were only a few feet from the first tank. Roofs of two of these tanks finally tore loose from the shells for several feet and burned intermittently at these openings. Firemen cooled these tanks with hose streams, but could not extinguish the fire at the leaking valve until they displaced the gasoline in the bottom of that tank by shooting water through the manhole from a water tower.

All five tanks were of the all-steel type with cone roofs equipped with 6-inch mercury seal vacuum and pressure vents and 18-inch top manholes with loose fitting covers. About 600 barrels of gasoline were lost from the leaking tank and only a few barrels from the others. The plant was equipped with a foam system and during the early stages of the fire the valves to four of the tanks were opened and the system put in operation. But in the excitement, valves of the yard hydrants were likewise opened, with the result that the entire storage of foam solutions (8000 gallons of each solution) was pumped on the ground and wasted. The plant also had 10,000 pounds of foam powder and three generators. The foam produced had little effect, as much of it was destroyed by water streams which were used simultaneously with the foam. The loss was about $25,000. (H-42042.)

Fires in Which There Was Loss of Life.

Last Quarter, 1937.

The last quarter of 1937 was accompanied by the usual increase in the number of fatal fires, especially those caused by defective heating equipment. Since the publication of the October QUARTERLY, the N.F.P.A. Department of Fire Record has received from various sources 234 reports of fires in which there was loss of life. A total of 440 lives were lost in the fires included in this tabulation.

Nine of the fires tabulated resulted in the loss of more than five lives each.

OCTOBER 12, 1937, BAYTOWN, TEXAS. The tanks of an oil tanker were being flushed with kerosene to prepare them for a cargo of oil. A kerosene hose broke, and the escaped liquid was ignited by a galley stove. Five of the crew were trapped and burned to death in their bunks, while a Chinese steward was cremated on deck. (H-42023.)

OCTOBER 16, 1937, MULGA, ALABAMA. A carbon monoxide explosion deep in a coal mine at Mulga crushed, burned, and suffocated 34 miners, all of whom died. A state mine inspector voiced the opinion that a match used to light a safety lamp had set off the explosive mixture. (H-42024.)

OCTOBER 19, 1937, WATERFORD, PA. A defective flue set fire to a farmhouse near Waterford. Four children, one man, and one woman were fatally burned. (L-4048.)

Struck by a fast passenger train on November 25, this empty gasoline tank truck and trailer took fire immediately. The charred body of the driver was found in the cab after the fire. Note the sign on the trailer: "This truck stops at railway crossings." (H-42040.)

OCTOBER 26, 1937, ANCHORAGE, ALASKA. An explosion in a coal mine 60 miles inland from Anchorage was fatal to fourteen miners. The immediate cause of the explosion was not determined. (H-42025.)

NOVEMBER 19, 1937, FORT COLLINS, COLO. Six persons living in an abandoned barn were suffocated and burned to death in a fire started by a coal stove. (See account on page 225.) (L-4049.)

DECEMBER 7, 1937, BRIDGETOWN, VA. In a two-story rural dwelling one woman and eight children were burned to death as they slept on the second floor. The cause of the fire was not reported. (L-4050.)

DECEMBER 9, 1937, KNOXVILLE, TENN. A defective flue in an old frame tenement house started a fire that fatally burned a man, two women, and six children. The fire chief called the building a "fire trap," although the city

Loss of Life Fires, October-December, 1937.*

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Class of Fire	No. Fires	Men	Women	Children	No Data	Total
Airplanes	2	3	0	0	0	3
Apartments, hotels, tenements, etc.	24	21	12	11	0	44
Automobiles, buses, trucks, motorcycles	16	13	6	3	0	22
Tank trucks	4	6	0	0	0	6
House trailers	5	0	1	12	0	13
Barns and stables	4	1	3	6	0	10
Camp recreation hall, C.C.C.	1	1	0	0	0	1
Churches	1	1	0	0	0	1
Clubs	1	1	1	0	0	2
Conflagrations	1	0	0	0	5	5
Dairy	1	1	0	0	0	1
Dwellings — Rural	56	37	29	62	0	128
Dwellings — Urban	61	20	25	30	0	75
Forest or brush fires	1	1	0	1	0	2
Garages	2	2	0	0	0	2
Gasoline filling stations	1	1	0	0	0	1
Ice house	1	0	0	2	0	2
Institutions	1	0	1	0	0	1
Manufacturing occupancy, miscellaneous	10	14	0	1	0	15
Mercantile occupancy, miscellaneous	3	5	1	0	2	8
Mining property	2	48	0	0	0	48
Out of doors	14	7	2	5	0	14
Pier, under-water chamber	1	1	0	0	0	1
Railroad rolling stock	1	4	0	0	0	4
Response to alarms	2	2	0	0	0	2
False alarms	1	1	0	0	0	1
Restaurants	3	4	0	0	0	4
Schools	2	2	0	0	0	2
College dormitory	1	1	0	0	0	1
Sheds and out-buildings	4	3	0	1	0	4
Tank vessels	1	6	0	0	0	6
Tents	2	0	1	6	0	7
No data	4	2	0	2	0	4
Totals	234	209	82	142	7	440

*This table is made up from those reports received by the Department of Fire Record between October 1, 1937, and December 31, 1937. A few of the fires included herein occurred prior to October 1, but were not reported until subsequent to that date.

building inspector said that it had never been officially condemned. Twenty-two other occupants jumped to the hard ground or escaped before the flames blocked the stairs (H-42026.)

DECEMBER 9, 1937, OREGON, ILL. Trapped while they slept in their burning rural dwelling, a woman and her six children were burned to death. The stairway was cut off by flames. (L-4051.)

DECEMBER 22, 1937, CONNELLSVILLE, PA. A hundred-year-old log cabin on a mountain farm near Connellsville was not immune to destruction when a man tried to start a fire in the kitchen stove with kerosene. The can of kerosene exploded, scattering flames all over the cabin and fatally burning a woman, two men, and three children. (L-4052.)

Foreign Fires.

Several outstanding loss of life fires outside the United States and Canada have been reported for this quarter. Foreign fires are not included in the tables. The most important are summarized here.

OCTOBER 25, 1937, At sea off HONGKONG, CHINA. A British steamer burned at sea with the loss of 30 lives. Many were thought to have jumped overboard and drowned.

NOVEMBER 13, 1937, VALPARAISO, CHILE. A fireworks factory was wrecked by an explosion and fire that took the lives of five men and three women.

NOVEMBER 30, 1937, PUERTO ANTEQUERA, PARAGUAY. A cargo of gasoline aboard a naval dispatch boat caused an explosion which killed twenty-one persons.

DECEMBER 21, 1937, TOMITA WAKAYAMA, JAPAN. In a village school a nitrocellulose film of the war in China was being shown to comfort the families of Japanese soldiers killed at the front. Eighty of the audience were killed when the film ignited.

DECEMBER 29, 1937, CALI, COLOMBIA. Flying in an electrical storm, three planes carrying seven persons burst into flames and crashed, leaving no survivors.

Typical Loss of Life Fires.

Automobile House Trailers.

OCTOBER 5, 1937, TOPPENISH, WASH. The parents of a baby girl locked her in their trailer home while they were away for a short time. When they returned they found the trailer in flames. The child had found some matches and set the fire. She was burned to death. (H-42027.)

NOVEMBER 9, 1937, STERLING, COLO. Playing with matches in a trailer on the outskirts of Sterling, three small children were burned to death. The trailer was destroyed. (H-42028.)

NOVEMBER 12, 1937, OLIVET, MICH. Five children, asleep in one bed in a trailer that had been converted into a temporary home, were burned to death. Their parents were not in the trailer when the fire started. (H-42029.)

Causes of Loss of Life, October-December, 1937.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Class of Fire	Men	Women	Children	No Data	Total
Airplane fires	3	0	0	0	3
Automobile, truck and motorcycle collisions	9	5	1	0	15
Tank truck fires	6	0	0	0	6
Automobile collided with tank truck	1	0	0	0	1
Chemicals and explosives:					
Blasting powder, dynamite, or dynamite caps	1	0	0	0	1
Chemicals in school laboratory	1	0	0	0	1
Fireworks — display	1	0	1	0	2
Fireworks — manufacturing	1	0	0	0	1
Nitrocellulose material	3	0	0	0	3
Nitroglycerin	1	0	0	0	1
Children alone in house	0	0	14	0	14
Children playing with matches	0	0	17	0	17
Clothing ignited:					
Bonfire, rubbish fires, etc.	1	0	3	0	4
Candle or torch	1	0	0	0	1
Jack-o'-lantern	0	0	1	0	1
Electric heater	0	0	1	0	1
Falling into fires	3	0	0	0	3
Fireplace or open grate	0	0	1	0	1
Furnace, stove, or heater	3	3	1	0	7
Matches	0	1	0	0	1
Oil stove, lamp, or heater	0	2	0	0	2
Smoking (see also smoking in bed)	6	3	0	0	9
Unknown — clothing ignited	2	0	0	0	2
Conflagrations	0	0	0	5	5
Entering or re-entering burning buildings	5	2	0	0	7
Escaping fires, jumped or fell	0	4	0	0	4
Explosions, miscellaneous:					
City gas, including gas appliances	1	2	0	0	3
Explosions not otherwise classified	2	0	1	0	3
Fire fighting — firemen	7	0	0	0	7
Flammable liquids and vapors:					
Alcohol explosions	2	2	0	0	4
Benzol explosion	3	0	0	0	3
Cleaning fluids, not otherwise classified	0	1	0	0	1
"Empty" tanks exploded	1	0	0	0	1
"Empty" molasses tank	1	0	0	0	1
Flammable liquids on tank ships	6	0	0	0	6
Gasoline lanterns and stoves	2	2	0	0	4
Filling gasoline stove	0	0	1	0	1
Home dry cleaning	0	5	0	0	5
Other cleaning with gasoline	1	0	0	0	1
Paints, varnishes, thinners, removers, etc.	1	0	0	0	1
Paraffin and gasoline waterproofing mixture	0	1	5	0	6
Oil stove explosions	3	3	4	0	10
Starting fires with gasoline	2	0	2	0	4
Starting fires with kerosene	4	7	4	0	15
Starting fires with other flammable liquids	1	0	0	0	1
Gasoline fires, not otherwise classified	1	0	0	0	1
Kerosene fires not otherwise classified	1	1	0	0	2
Flammable liquids, not otherwise classified	4	2	0	0	6
Forest or brush fires (including fire fighting)	1	0	1	0	2
Indirect causes:					
Over-exertion at fires, civilians	1	0	0	0	1
Over-exertion at fires, firemen	3	0	0	0	3
Response to alarms	2	0	0	0	2

Class of Fire	Men	Women	Children	No Data	Total
Indirect causes, cont'd:					
Suicide resulting from fire	1	0	0	0	1
Traffic accidents due to fires	2	0	0	0	2
Mine fires and explosions	48	0	0	0	48
Overcome by smoke, suffocation	8	3	6	0	17
Railroad rolling stock	4	0	0	0	4
Smoking in bed	4	0	0	0	4
Trapped in burning buildings	41	31	73	2	147
Trapped in Christmas tree fires	2	2	2	0	6
No data, burned	1	0	3	0	4
Totals	209	82	142	7	440

NOVEMBER 14, 1937, PASADENA, CALIF. In a public park, a woman was in the bedroom of her trailer when the portable gasoline stove in the kitchen exploded. She was suffocated in the fire that followed. (H-42030.)

DECEMBER 13, 1937, HARTFORD CITY, IND. A woman built a fire in the stove of her trailer home and then, leaving her three children, went out to get a pail of water. When she returned the trailer was destroyed by fire, and the children dead. (H-42031.)

Alcohol Explosions.

OCTOBER 1, 1937, GRAND COULEE DAM, WASH. Dinner was being prepared for the thousands who had come to the dam during President Roosevelt's visit, when an alcohol stove exploded, killing two men. (L-4055.)

OCTOBER 18, 1937, OMAHA, NEB. Two boys burning trash in a furnace used radiator alcohol to enliven the blaze. The flare-up ignited their clothing, burning one of them fatally. (L-4056.)

NOVEMBER 13, 1937, ST. LOUIS, MO. A whiskey still in the basement of a St. Louis woman's home exploded, killing her. The damage was confined to the basement. (L-4054.)

NOVEMBER 19, 1937, ST. LOUIS, MO. While a woman was preparing breakfast a can of antifreeze alcohol became overheated and exploded. The alcohol was ignited immediately and set fire to her clothes. She was burned to death. (L-4053.)

Christmas Tree Fires.

DECEMBER 26, 1937, NEW YORK, N. Y. A Christmas tree ignited in an apartment from an unknown cause. The flare-up trapped and burned to death a four-year-old child. (H-42033.)

DECEMBER 26, 1937, LOS ANGELES, CALIF. A heater ignited a Christmas tree in a dwelling. A woman and a child were trapped in a second floor bedroom and burned to death by the fast spreading flames. (L-4057.)

DECEMBER 29, 1937, JERSEY CITY, N. J. A Christmas tree in the lobby of a large hotel was ignited, perhaps by a spark from a toy electric train. The whole tree blazed up at once, causing panic throughout the building. Two hotel employees were suffocated. (H-42032.)

Acme.

On December 22, the kerosene heater in the center of the picture above set fire to this basement apartment of a resident of Thornewood, N. Y. A cripple, he shouted the alarm to other occupants of the building, but was burned to death. (H-42041.)

Falling into Fires.

SEPTEMBER 9, 1937, EDWARDSVILLE, MO. A 73-year-old farmer, burning brush in a field, was overcome by the heat and fell into the fire. He was burned to death. (L-4058.)

NOVEMBER 9, 1937, PRINCE GEORGES COUNTY, MD. A man was fatally burned as he attempted to burn a field near his home. He fell into a brush fire he had started. (H-42039.)

Fireworks.

JULY 21, 1937, PITTSBURG, KAN. A small child was fatally burned while playing with fireworks left over from a July Fourth celebration. (L-4059.)

AUGUST 16, 1937, CHICAGO, ILL. At a festival fireworks were being displayed. A large bomb used to climax the show tipped over, and fired into the crowd. The operator was killed and several onlookers were seriously injured. (L-4060.)

Gasoline Fires and Explosions.

SEPTEMBER 11, 1937, CHICAGO, ILL. Two women were cleaning a mattress with gasoline. One was holding a cup of the liquid in her hand. The other lit a match for illumination. They were both burned to death in the fire. (L-4061.)

DECEMBER 1, 1937, PEORIA, ILL. A woman who was using a blow torch to thaw out frozen pipes in her home asked her son to fill the gasoline stove.

This he did and when done put the can of gasoline down on the floor near the torch which his mother had left burning. The explosion was fatal to the boy. (L-4062.)

DECEMBER 18, 1937, WAYZATA, MINN. A man was pouring a can of gasoline into a stove to start a fire in his farm dwelling. When the explosion occurred the flaming gasoline spread the fire throughout the house. The man and two young children were burned to death. (L-4063.)

Escaping Automobile Fire.

SEPTEMBER 12, 1937, LYONS, KANSAS. When flames appeared under the hood of the automobile in which she was riding, a woman leaped from the back seat with her young child in her arms. She struck her head on the pavement and was fatally injured. The child was thrown to a grassy spot and was unhurt. (H-42034.)

Reëntering Burning Buildings.

NOVEMBER 20, 1937, MOUND, MINN. When her home was ignited by a defective stove, a woman saved her three children, and then returned to try and get some clothes for the youngest. She was trapped and died in the house, while the baby was burned to death on the porch where she had left him. (L-4064.)

DECEMBER 13, 1937, HOOKSETT, N. H. Thinking that his wife had been trapped in a burning house, a man rushed in to save her and was trapped and burned to death. The woman had escaped. (L-4065.)

Tent Fires.

NOVEMBER 5, 1937, TALLAPOOSA, MO. A child, sleeping alone in a tent used as a temporary dwelling for his family on a farm near Tallapoosa, was burned to death when the tent caught fire. (L-4067.)

NOVEMBER 21, 1937, CAUSEY, N. M. A family living in a tent house in Causey were waterproofing their home with a mixture of paraffin and gasoline. The mixture was ignited by a stove on which it was being heated, and in the fire a woman and five children were burned to death. (L-4068.)

Chemical Explosion in School.

NOVEMBER 10, 1937, NEW BEDFORD, MASS. A student compounding gun powder in the laboratory of his school was fatally injured when the mixture exploded. Several other students were injured. (H-42036.)

Traffic Accidents.

NOVEMBER 20, 1937, BLOOMFIELD, N. J. Answering a false alarm, the chief of the fire department was killed in an automobile accident. (L-4069.)

DECEMBER 5, 1937, NORWAY, MAINE. A man ran from his burning home to awaken a neighbor. As he ran into the road he was struck by a passing automobile and instantly killed. The driver of the automobile did not know he had hit anything, but noticed the fire and gave the alarm in Norway village. After returning to the fire he noticed that one headlight was missing and a fender badly battered. He was held for manslaughter. (L-4070.)